ALKOR-Berichte

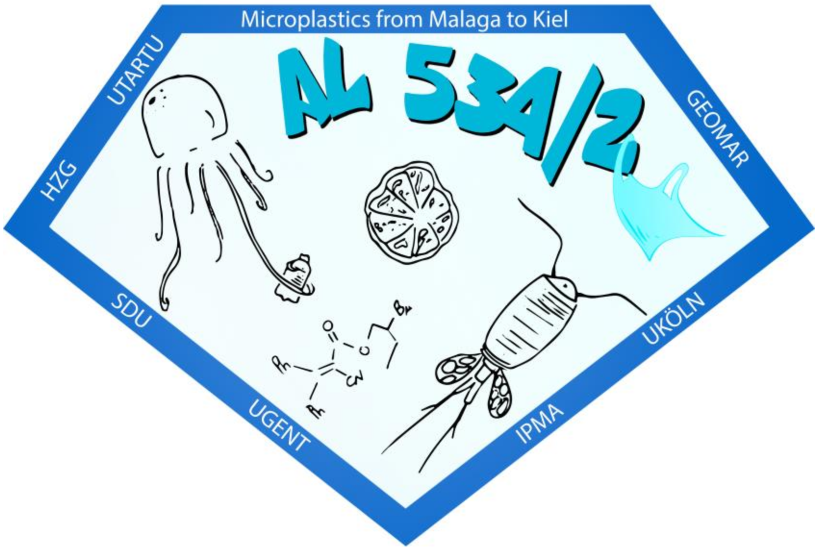
RiverOceanPlastic: Land-ocean transfer of plastic debris in the North Atlantic

Cruise No. AL534/2

05 March – 26 March 2020

Malaga (Spain) – Kiel (Germany)

RiverOceanPlastic



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2020

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1 Cruise Summary

1.1 Summary in English

Cruise AL534/2 is part of a multi-disciplinary research initiative as part of the JPI Oceans project HOTMIC and sought to investigate the origin, transport and fate of plastic debris from estuaries to the oceanic garbage patches. The main focus of the cruise was on the horizontal transfer of plastic debris from major European rivers into shelf regions and on the processes that mediate this transport. Stations were originally chosen to target the outflows of major European rivers along the western Europe coast between Malaga (Spain) and Kiel (Germany), although some modifications were made in response to inclement weather. In total, 16 stations were sampled along the cruise track. The sampling scheme was similar for most stations, and included: 1) a CTD cast to collect water column salinity and temperature profiles, and discrete samples between surface and seafloor, 2) sediment sampling with Van Veen grab and mini-multi corer (mini-MUC), 3) suspended particle and plankton sampling using a towed Bongo net and vertical WP3 net, and 4) surface neusten sampling using a catamaran trawl. At a subset of stations with deep water, suspended particles were collected using in situ pumps deployed on a cable. During transit between stations, surface water samples were collected from the ship's underway seawater supply, and during calm weather, floating litter was counted by visual survey teams. The samples and data collected on cruise AL534/2 will be used to determine the: (1) abundance of plastic debris in surface waters, as well as the composition of polymer types, originating in major European estuaries and transported through coastal waters, (2) abundance and composition of microplastics (MP) in the water column at different depths from the sea surface to the seafloor including the sediment, (3) abundance and composition of plastic debris in pelagic and benthic organisms (invertebrates), (4) abundance and identity of biofoulers (bacteria, protozoans and metazoans) on the surface of plastic debris from different water depths, (5) identification of chemical compounds ("additives") in the plastic debris and in water samples.

1.2 Zusammenfassung

Die Fahrt AL534/2 ist Teil einer multidisziplinären Forschungsinitiative im Rahmen des JPI Oceans-Projekts HOTMIC und hatte zum Ziel, die Herkunft, den Transport und das Schicksal von Plastikmüll von den Flussmündungen bis hin zum ozeanischen Müllstrudel im Nordatlantik zu untersuchen. Der Fokus der Fahrt lag auf dem horizontalen Transport von Plastikmüll aus den großen europäischen Flüssen in die Schelfregionen und auf den Prozessen, die diesen Transport beeinflussen. Die Stationen wurden so gelegt, dass sie im Bereich der Mündungen der großen europäischen Flüsse entlang der westeuropäischen Küste zwischen Malaga (Spanien) und Kiel (Deutschland) lagen. Aufgrund von schlechtem Wetter mussten jedoch einige Änderungen am ursprünglichen Plan vorgenommen werden. Insgesamt wurden 16 Stationen entlang der Fahrtroute beprobt. Das Probenahmeschema war für die meisten Stationen gleich: 1) eine CTD-Beprobung zur Erfassung der Salinitäts- und Temperaturprofile innerhalb der Wassersäule sowie einzelne Messungen zwischen Oberfläche und Meeresboden, 2) Sedimentprobennahme mit einem Van-Veen-Greifer und einem Mini-Multi-Corer (Mini-MUC), 3) Partikel- und Planktonprobennahme mit einem horizontal geschleppten Bongo-Netz und einem vertikal gehievten WP3-Netz und 4) Neustonprobennahme mit einem Katamaran-Trawl. An Stationen mit einer ausreichenden Wassertiefe wurden suspendierte Partikel mit Hilfe von in situ Pumpen gesammelt. Während des Transits zwischen den Stationen wurden Oberflächenwasserproben aus der Seewasserversorgung des Schiffes entnommen, und bei ruhigem Wetter wurden schwimmende Müllteile visuell gezählt. Proben und Daten, die auf der Ausfahrt AL534/2 gesammelt wurden, werden benutzt, um Folgendes zu bestimmen: (1) Abundanz und Zusammensetzung (Polymertyp) von Plastikmüll im Oberflächenwasser, der aus den großen europäischen Flussmündungen stammt und der durch die Küstengewässer transportiert wird, (2) Abundanz und Zusammensetzung von Mikroplastik (MP) in der Wassersäule in verschiedenen Tiefen von der Meeresoberfläche bis zum Meeresboden einschließlich des Sediments, (3) Abundanz und Zusammensetzung von Plastikmüll in pelagischen und benthischen Organismen (Invertebraten), (4) Abundanz und Identität von Biofoulern

(Bakterien, Protozoen und Metazoen) auf der Oberfläche von Plastikmüll aus verschiedenen Wassertiefen, (5) Identifikation von chemischen Verbindungen ("Additives") im Plastikmüll und in Wasserproben.

2 Participants

2.1 Principal Investigators

Name	Institution
Achterberg, Eric, Prof. Dr.	GEOMAR
Beck, Aaron, Dr.	GEOMAR
Haeckel, Matthias, Dr.	GEOMAR
Lenz, Mark, Dr.	GEOMAR

2.2 Scientific Party

Name	Discipline	Institution
Beck, Aaron	Marine Chemistry / Chief Scientist	GEOMAR
Goldstein, Josi	Marine Biology	SDU
Hamisch, Stephan	Marine Chemistry	GEOMAR
Javidpour, Jamileh	Marine Biology	SDU
Kossel, Elke	Marine Geochemistry	GEOMAR
Lopes, Clara	Microplastics	IPMA
Panto, Gabriella	Benthic Ecology	UGent
Peterson, Anneliis	Benthic Ecology	UTartu
Saupe, Anna	Micropalaeontology	UKöln
Weber, Karina	Marine Geochemistry	GEOMAR
Wittmann, Andreas	Marine Chemistry	HZG

2.3 Participating Institutions

GEOMAR	Helmholtz Centre for Ocean Research Kiel (Germany)
SDU	University of Southern Denmark (Denmark)
IPMA	Instituto Português do Mar e da Atmosfera (Portugal)
UGent	Ghent University (Belgium)
UTartu	University of Tartu (Estonia)
UKöln	University of Cologne (Germany)
HZG	Helmholtz-Zentrum Geesthacht (Germany)

3 Research Program

3.1 Aims of the Cruise

The coastal and open oceans represent a major, but yet unconstrained, sink for plastics. It is likely that plastic-biota interactions are a key driver for the fragmentation, aggregation, and vertical transport of plastic litter from surface waters to sedimentary sinks. However, the magnitude of the plastic flux as well as the flux rates from the rivers to coastal waters and the open ocean, and from the surface to deep waters, are very poorly constrained, as is the impact of plastic-biota interactions on transport and ecological health. Cruise AL534/2 integrates riverine source observations and shelf sea sampling to build a mechanistic understanding of MP transport and its biological impact reaching from rivers to the coastal water column and sinks at the seabed.

Cruise AL534/2 serves as a second cruise of a number of connected research cruises to build an understanding of the transport pathways of plastic and microplastic debris in the North Atlantic from the input through rivers and air across coastal seas into the accumulation spots in the North Atlantic gyre and the vertical export to its sink at the seabed. The first cruise (POS536) was conducted during August-September 2019 and visited the inner accumulation zone of the North Atlantic garbage patch (in the North Atlantic gyre) and focused on vertical transport processes. The current cruise will focus on land-ocean transfer of MPs and determine the fate of plastics (including larger size classes (>5 mm, MP, but also sub-MP) during transfer from rivers to coastal waters and towards ocean waters.

The cruise is an international effort as part of the JPI Oceans project HOTMIC. The cruise forms a joint effort of HOTMIC researchers from a range of countries and institutes. The institutes involved are: GEOMAR (Germany): water column biogeochemistry (Prof. Dr. Eric Achterberg, Dr. Aaron Beck), benthic ecology (Dr. Mark Lenz), sediment biogeochemistry (Dr. Matthias Haeckel), physical oceanography (Prof. Dr. Arne Biastoch, Dr. Marcus Dengler). The Institute of Water Chemistry & Chemical Balneology, Technical University of Munich (Germany): analytical measurements of MPs and sub-MPs (Dr. Natalia P. Ivleva). University of Pisa (Italy): nanoparticle and MP measurements using advanced analytical techniques (Prof. Valter Castelvetro). University of Southern Denmark (Denmark) plankton ecology (Prof. Jamileh Javidpour). Portuguese Institute for Marine and Atmospheric Science (Portugal): Investigating MP distribution in ocean (Dr. Miguel Caetano). Marine and Environmental Science Centre (Portugal): Marine litter mapping (Dr. João Canning Clode). Ghent University (Belgium): benthic biology (Prof. Ann Vanreusel). University of Tartu (Estonia): MP and marine biodiversity (Prof. Jonne Kotta).

3.2 Agenda of the Cruise

Cruise AL534/2 took advantage of a planned transit in which RV Alkor returned from a working area in the Mediterranean Sea to hope port in Kiel, Germany. The cruise covered the entire western mainland European coast, from the Strait of Gibraltar to the Elbe River mouth. Stations were chosen along the route to target estuarine outflows from the major river systems, as well as provide good coverage of western Europe shelf seas.

The planned work during AL534/2 included a variety of sampling methods that would be repeated at every station: 1) a CTD cast to collect water column salinity and temperature profiles, and discrete samples between surface and seafloor, 2) sediment sampling with Van Veen grab and mini-multi corer (mini-MUC), 3) suspended particle and plankton sampling using a towed Bongo net and vertical WP3 net, and 4) surface neusten sampling using a catamaran trawl. At a subset of stations with deep water(>100 m), in situ pumps were planned to collect suspended particles from 500-1000 L water between surface and seafloor. Additional sampling was planned throughout the cruise track, including, surface water sample collection from the ship's underway seawater supply, and during calm weather, floating litter surveys to count the abundance of floating debris.

3.3 Description of the Work Area

The working area is located in the NW European shelf area, including outflows of major European rivers, as source regions or intermediates for transport to the plastic garbage patch of the North Atlantic gyre. Surface current transport tends to be poleward along the western European shelf margin and from the Bay of Biscay toward the Atlantic, although eddy formation can enhance offshore transport (Santos et al., 2002; Coelho et al., 2002). Poleward transport along the shelf margin converges with southward currents along the Ireland coast and enters the North Atlantic Gyre (e.g., Gröger et al, 2013).

The shelf width varies over the cruise region from 10–60 km off Portugal and Spain, to 100–150 km in eastern Biscay. Typical shelf depths are around 100 to 200m from Gibraltar to Biscay. The English Channel and southern North Sea are much shallower, at generally less than 40 m depth. The continental slope is steep along Spain and Portugal, and is indented with several large canyons off Portugal and in southern Biscay.

The distribution of microplastic debris in European coastal waters is heterogeneous (e.g., Maes et al., 2018), but there are clear hotspots at river mouths (Galgani et al., 2000). The putative river source of most plastic debris in this region appears to be increasing over the past several decades (Maes et al., 2018). Reported macroplastic litter densities are especially high in certain regions of the planned study region, including south Portugal and the Bay of Biscay, and the litter abundance is directly proportional to proximity to the coast (Pham et al., 2014). Microplastic abundances on beaches along the planned cruise track are also some of the highest observed throughout Europe (Lots et al., 2017).

Abundant macroplastic debris represents the largest mass of plastic on European beaches (Van Cauwenberghe et al., 2013), and is the likely source of much of the microplastics in coastal waters (Martins and Sobral., 2011¸ Claessens et al., 2011). In the water column, the mass of microplastics can exceed that of macroplastics (Van Cauwenberghe et al., 2013), and microplastics are also more abundant by number on beaches (Martins and Sobral., 2011). Both macro- and microplastics can have deleterious effects on marine ecosystems, and the distribution of these stressors is therefore important to constrain.

The work conducted during AL534/2 will be informed by separate sampling activities undertaken by a Portuguese group in coastal zones around and between the Azores archipelago as part of the HOTMIC project as these are extensively contaminated with plastic debris (Pieper et al., 2015;

Pieper et al., 2016; Chambault et al., 2018). Due to oceanographic circulation structures, the Azores act as a retention zone for plastic debris from Europe (Chambault et al., 2018), and the interface between continental sources and the open ocean accumulation zone. Similar plastic debris is present in Ireland coastal and continental shelf waters (Lusher et al., 2014; Martin et al., 2017), and as part of HOTMIC samples will be collected by an Irish group. Ireland is positioned at the Gulf Stream eastern divergence, and provides the link between southward transport into the North Atlantic gyre.

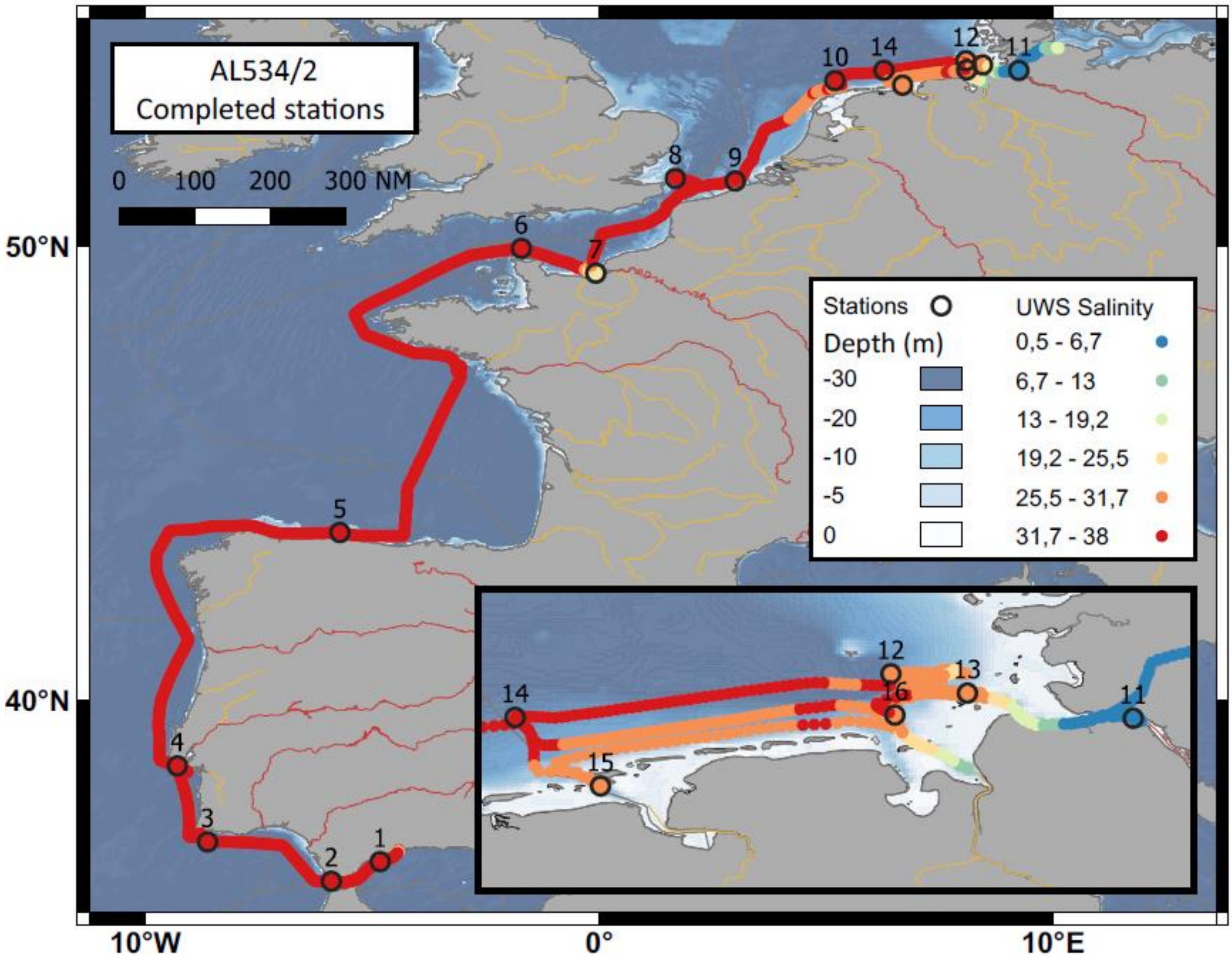

Fig. 3.1: Track chart of R/V ALKOR Cruise AL534/2. Bathymetry from GEBCO (2020). Salinity data from underway thermosalinograph are shown along the cruise track.

4 Narrative of the Cruise

RV Alkor departed from Malaga on 06 March 2020, and arrived at the first station in the afternoon (Station 1; Fig. 3.1). The sampling plan was similar for most stations, and included: 1) a CTD cast to collect water column salinity and temperature profiles, and discrete samples between surface and seafloor, 2) sediment sampling with Van Veen grab and mini-multi corer (mini-MUC), 3) suspended particle and plankton sampling using a towed Bongo net and vertical WP3 net, and 4) surface neusten sampling using a catamaran trawl. At a subset of stations with deep water, suspended particles were collected using in situ pumps deployed on a cable. During transit between stations, surface water samples were collected from the ship's underway seawater supply, and during calm weather, floating litter was counted by visual survey teams.

During the first days of the cruise, we completed stations inside the mouth of the Mediterranean Sea (Sta. 1), in the Gibraltar Strait (Sta. 2), and southwest of the Portuguese city of Sagres (Sta. 3). Throughout the cruise, we had to contend with long transit distances between stations and seasonal high winds and waves that prevented sampling. The Atlantic coast of Portugal and Spain is notorious for rough seas. We successfully sampled a station offshore of Lisbon (Portugal; Sta. 4) after sheltering from high winds the previous evening, and took advantage of favorable weather to transit an additional 24 h around the Costa da Morte (Death Coast) to a sheltered headland at Gijón, Spain (Sta. 5). The following day brought glassy water with high, rolling swell that allowed a slow transit across the Bay of Biscay. Two days were lost due to poor weather while we sheltered leeward of Belle-Île-en-Mer, France, followed by a long transit the following day into the English Channel. We completed a station in the Channel on 17 March (Sta. 6). We sampled Station 7 the following day, offshore La Havre (France) at the mouth of the Seine River.

On the morning of 19 March, we completed a station at the mouth of the Thames River (Sta. 8). We took heed of a worsening weather forecast to immediately transit to the Belgium coast and sample another station (Sta. 9). We completed the next station (Sta. 10) off the Dutch island of Terschelling before the poor weather caught up to us. The next two days were spent waiting for improved weather in port in Cuxhaven, Germany. On 23 March, we sampled Station 11 in the Elbe River, near Brunsbüttel, Germany. River currents made sediment and net sampling a challenge. This was followed in rapid succession by stations near the German island Helgoland (Sta. 12), the mouth of the Elbe River (Sta. 13), offshore the Frisian Islands at the NL-DE EEZ border (Sta. 14), and the mouths of the Ems (Sta. 15) and Weser Rivers (Sta. 16).

We transited through the Kiel Canal ahead of inclement weather on 26 March, and arrived at port at GEOMAR. Despite the large geographical coverage and intermittent working days lost to poor weather, cruise AL534/2 was successful in achieving almost all of its objectives.

Table 1. Overview of sampling stations

Station No.	DSHIP ID	Date / Time	Latitude (deg N)	Longitude (deg E)	Water Depth (m)	Remarks/Recovery
1	AL534/2_1	06.03.2020 13:58	36.4286	-4.8292	155	Full station (CTD rosette, mini-MUC, Van Veen grab, Bongo net, WP3 net) except no catamaran trawl due to high waves.
2	AL534/2_2	07.03.2020 07:02	35.9971	-5.9053	179	No sediments due to hard bottom. Otherwise full station, including in situ pumps.
3	AL534/2_4	08.03.2020 11:01	36.8636	-8.634	252	Full station
4	AL534/2_7	10.03.2020 07:02	38.54	-9.3005	122	Full station
5	AL534/2_17	12.03.2020 08:27	43.6846	-5.7163	102	Full station, including in situ pumps. Three additional WP3 casts.
6	AL534/2_29	17.03.2020 09:03	49.9489	-1.7154	75	CTD and nets. Only one catamaran trawl. No sediments due to hard bottom.
7	AL534/2_31	18.03.2020 06:58	49.4022	-0.0745	17	Full station. Box core used for sediments instead of mini-MUC.
8	AL534/2_35	19.03.2020 07:00	51.4902	1.6794	32	Full station
9	AL534/2_37	19.03.2020 15:50	51.4335	2.9997	18	Full station
10	AL534/2_39	20.03.2020 11:07	53.6466	5.1975	27	Full station
11	AL534/2_41	23.03.2020 09:17	53.8708	9.2504	16	Elbe station; limited sediments and no Bongo or WP3 net due to currents.
12	AL534/2_48	24.03.2020 06:56	54.0846	8.0845	21	Full station, but no catamaran due to high waves.
13	AL534/2_49	24.03.2020 11:13	53.9919	8.4528	14	Full station
14	AL534/2_50	25.03.2020 06:52	53.8752	6.2776	31	CTD cast for sensor data, and WP3 net only.
15	AL534/2_52	25.03.2020 10:31	53.5452	6.6882	22	Full station
16	AL534/2_60	25.03.2020 23:35	53.8862	8.104	17	Full station

5 Preliminary Results

5.1 CTD Measurements and Sampling for Dissolved Plastic Leachates and Anthropogenic Organic Compounds

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Background and Objectives

From a chemical perspective, plastic debris constitutes mixtures of polymer, residual monomers, additives and absorbed chemical contaminants from the environment (Koelmans et al., 2016; Galloway et al., 2017; Gallo et al, 2018). Adsorbed environmental contaminants include toxic, low molecular weight species that can be transferred to animal tissues if the contaminated plastic debris is ingested. Biologically-active adsorbed compounds such as endocrine disruptors have the potential to influence metabolic pathways as well as reproductive success (Koelmans et al., 2016).

Plastic additives can leach into seawater (Teuten et al., 2009), both altering the chemical composition of the residual MP and leaving a chemical trace in the dissolved phase. Degradation of MP in seawater can occur via a variety of mechanisms, but photodegradation (UV), oxidation, leaching of polymers, and physical degradation are likely the most important (Gewert et al., 2015). Additive leaching can accelerate physical alteration during MP weathering, including cracking, pitting, erosion, and color change (Fotopoulou and Karapanagioti, 2015; ter Halle et al., 2017; Tang et al., 2018; Resmerita et al., 2018; Paluselli et al., 2019). Leaching effects by UV irradiation vary with different polymers, but microbial colonization of plastic surfaces leads to polymer-independent accelerated leaching of plasticizers (Paluselli et al., 2019). Leaching of plastic additives can lead to both direct and indirect exposure to marine biota (Teuten et al., 2009; Koelmans et al., 2014). The presence of these leachates has been shown in the southwest Baltic Sea (Erhardt and Derenbach, 1980) and the northwest Mediterranean Sea (Paluselli et al., 2018). It remains unknown how chemical signatures of MP leachates in the dissolved phase correspond to presence of MP in the ocean.

The objectives of this work are to:

1. To characterize the weathering condition of MP particles sea surface from major European rivers, through coastal waters to the open North Atlantic
2. To determine the distribution, composition, and concentration of dissolved plastic additive compounds along vertical and horizontal transport pathways

Methods

Water column samples were collected using a HydroBIOS MWS 12 rosette water sampler equipped with a CTD. CTD profiles were recorded at the 16 sampling stations occupied during the cruise. Samples from the water column were taken from up to 12 depths (depending on water depth). Discrete water samples were collected from the Niskin bottles for a variety of analyses including plastic additive leachates and other anthropogenic organic compounds (discussed here), emerging organic pollutants (Section 5.2), and microplastics (Section 5.3).

The additives were collected and pre-concentrated from water samples (1- 4 l) on solid phase extraction (SPE) cartridges and returned to our home laboratory for analysis (following extraction using a solvent) on liquid chromatography mass spectrometry (LC-MS) and also Gas

Chromatography (GC)-MS (Pouech et al., 2014). The facilities are available in the laboratory of Eric Achterberg, and the analytical protocols for additive analyses in seawater have been established. Standards of chemical plastic additives are also available, and include a range of phthlates, Benzoic acid, 3,4 dimethyl, Phenol, 3,5 bis(1,1 dimethylethyl), 4,4'-(propane-2,2-diyl)diphenol (Bisphenol A), and 38 other relevant compounds. Surface water samples were also taken via the underway water supply during transits between stations.

In addition to sampling water, we will also determine the concentration of additives in plastic particles that were collected by the catamaran trawl (surface), the multi-net trawl (water column) and the *in situ* pumps (water column). Extraction will be performed under a plastic-free environment in order to prevent the background contamination (except those materials that are not replaceable). The collected particles will be weighed and subsequently extracted by sonication using different solvents. The individually extracted samples will be streamed through preconditioned solid phase extraction (SPE) column. Upon elution, the purified samples can be further concentrated through evaporation under nitrogen at room temperature. GCMS and LCMS analysis will be performed after diluting the aforementioned extract with 200 µL of a polar solvent (Pouech et al., 2014).

Preliminary results

Depth profiles of salinity and temperature are shown in Fig. 5.1. Deep stations tended to show mixed layers in the upper 20 m or so, whereas shallow stations were generally well-mixed throughout the water column. Stations 1 and 2 showed the high salinity and temperature characteristic of the Mediterranean Sea. Station 11 (Elbe River) was the only fully freshwater station, although many stations show low salinity surface layers indicative of river outflows.

Work to be conducted in home laboratory

Sample processing for dissolved plastics leachates and anthropogenic organic compounds will be conducted in laboratories at GEOMAR. Sample analysis is planned for early 2021.

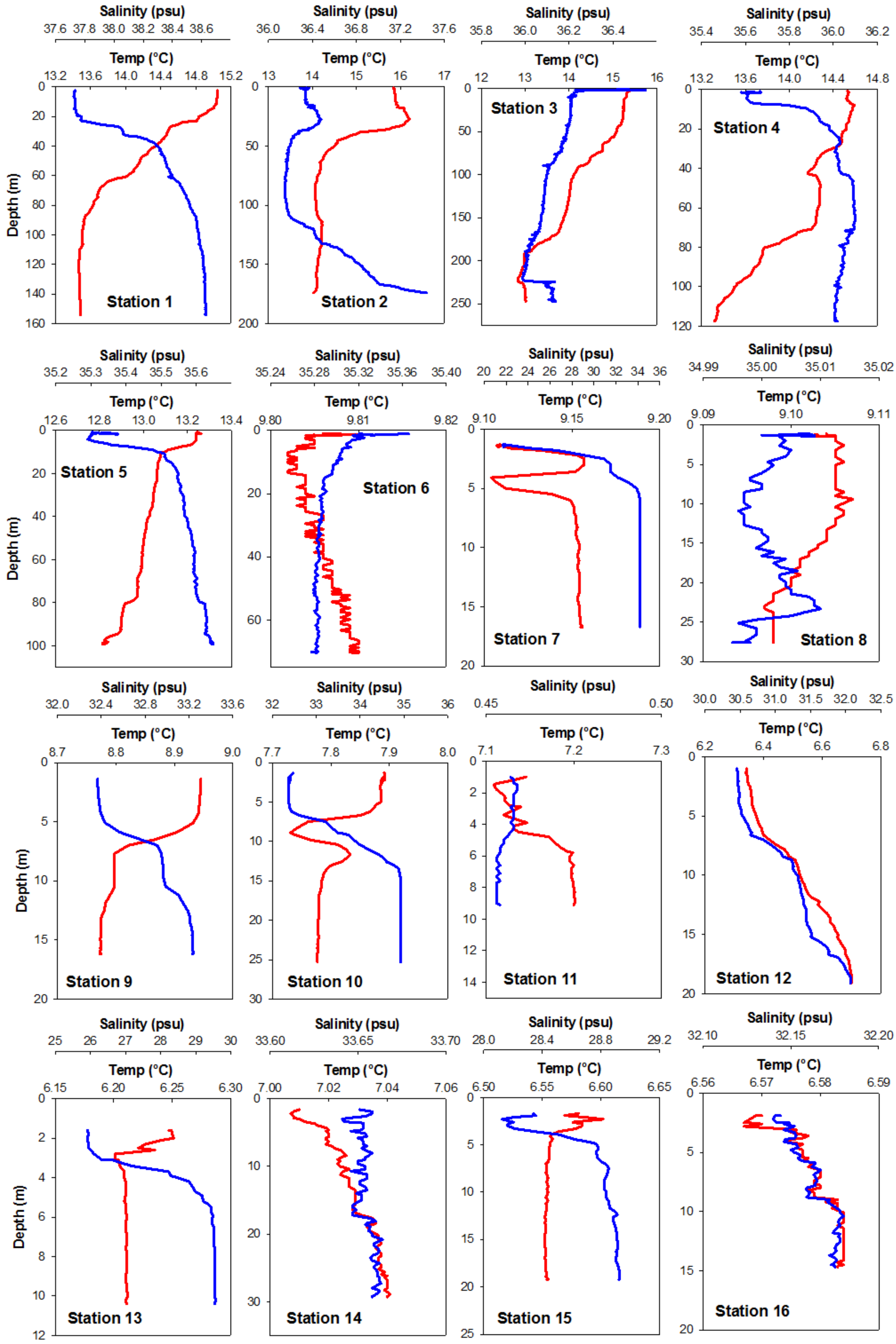

Figure 5.1: Depth profiles of water column salinity and temperature. Station IDs correspond to those indicated in Fig. 3.1 and Table 1.

5.2 Occurrence and distribution of selected emerging organic pollutants along the European coastline, from Malaga to Kiel.

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Background and Objectives

The main objective of this sampling campaign is an assessment of the contamination status of emerging organic contaminants (EOCs) in the waters and sediment of the North Atlantic, Biscay Bay and the North Sea along the coastline of several European countries. The highly industrialized and urbanized societies of our current world produce and thrive on a plethora of chemical compounds, used to produce consumer goods and to build and maintain various other parts of the economic system. Many anthropogenic chemicals that are produced and used in large quantities are not readily completely degradable and thus tend to end up in the environment. Due to the continuous developments and changes in industry, economy and the regulatory framework, different and new organic chemicals are released to and appear in the environment (EOCs). Most of them have a dimension of toxicity to them, which is another factor that makes it important to assess their occurrence and distribution in different environmental compartments.

The focus of this work includes several groups of EOPs, such as current use pesticides (CUPs), per- and polyfluoroalkyl substances (PFAS), flame-retardants, organic UV absorbers and preservatives. All of them are detected ubiquitously in the (marine/aquatic) environment and are associated with particular detrimental effects on living organisms. Of particular interest for our research are the influence of riverine inputs on the contaminant concentration levels, the contaminant distribution along the continental slope in the Biscay bay and potential point contamination sources along the cruise track.

Methods

Sampling

During AL534-2 a total of 196 water samples were collected through the ship seawater intake system (172 samples) and the CTD/rosette sampler (24 samples). 88 samples were collected at general sampling stations, while 84 samples were collected at underway stations during transit. For each sample, 1 L water was collected in pre-cleaned PP or glass bottles, depending on the target substance group. Sample triplicates were carried out at several stations in order to enable a statistical evaluation of the analytical method. Water samples in PP bottles were frozen and stored at -20°C until analysis, whereas glass bottles were stored at 4 °C in the cooling room of the MS Alkor and the laboratory temperature constant room.

Sediment grab samples were collected at general stations using an Van Veen grab sampler operated with the ship winch, frozen and stored in aluminum shells at -20°C. Upon arrival in the lab, the sediment samples were freeze-dried and further stored at -20°C. Sediment samples will be used for the analysis of UVAs, CUPs and potentially other groups of EOCs.

Bulk plankton samples were collected at all general stations, except station 1 and 2, with a Bongo Net (100 µm mesh size). Plankton samples were wrapped in aluminum foil, frozen and stored at -20°C. Plankton was freeze-dried with the sediment samples and is stored at -20°C until analysis of UVAs.

Analytical methods

For PFAS analysis, 1 L water samples were filtered in the home laboratory at Helmholtz-Zentrum Geesthacht, spiked with mass-labelled internal standards (50 µL, 60 pg/µL) and loaded onto preconditioned solid phase extraction cartridges (Waters Oasis WAX; 6cc, 500 mg, 30 µm). After a washing step, the target compounds were eluted using methanol and 0.1 % ammonium hydroxide in methanol. The eluates were reduced to 150 µL under nitrogen and [$^{13}C_8$]-PFOA was added as injection standard (10 µL, 100 pg/µL). The sample extracts were analysed for 35 PFAS using liquid chromatography tandem mass spectrometry (LC-MS/MS).

For the determination of 7 neonicotinoids, 3 new generation insecticides, fipronil and some of their metabolites in water, an automated solid phase extraction is carried out on a LC-Tech XANA Freestyle workbench. Samples are spiked with internal standard mixture, pre-concentrated on Oasis HLB SPE cartridges (6 cc., 500 mg) and, after a washing step, eluted with 10 mL methanol. The eluate is evaporated under nitrogen to a volume of 800 µL and diluted with Milli-Q water in a ratio of 1:10. Injection standard (BP-d10) is added and the sample is filtered through a syringe filter, before analysis. Chromatographic separation and subsequent quantification of the targeted insecticides is achieved using an Agilent 1290 LC system coupled with an Agilent 6490 triple quadrupole mass spectrometer. The same LC-QqQ combination is employed to quantify Glyphosate and AMPA. Briefly, the water samples are filtrated and then loaded into affinimip SPE (solid-phase extraction) cartridges. Thereafter, the eluate is derivatized with FMOC-Cl (9-Fluorenylmethoxycarbonyl chloride). The derivatized samples are then loaded onto Strata-X Polymeric Reversed Phase 200mg/6cc cartridges and eluted with 9 mL MeOH. The final eluate is evaporated with a gentle flow of N2 at 60°C to reduce the final volume to 150 µL. All samples are to be analyzed by HPLC-ESI-MS/MS. A method to extract CUPs from sediment will be developed during 2021 and will be used to analyze their occurrence in the collected sediment samples.

For the analysis of UVAs and parabens in water, 1 L sample is spiked with 10 ng of internal standards (4 mass-labeled parabens and 8 mass-labeled UVAs), enriched on Oasis HLB cartridges (6 cc., 500mg) and eluted with 13 mL of ethyl acetate/dichloromethane (1:1, v:v), using a LC-Tech XANA Freestyle workbench. The eluate is solvent exchanged to methanol, reduced in volume and diluted with Milli-Q water to reach a final volume of 1 mL (H_2O:MeOH, 60:40; v:v). The analytical workflow for the analysis of UVAs in sediment follows the method published by Apel et al (2018) and includes an accelerated solvent extraction (ASE) of 5 g sediment with dichloromethane and an in-cell cleanup. The method for the determination of UVAs in plankton samples is still under development. As a preliminary workflow, freeze-dried and homogenized bulk plankton is spiked with internal standards, extracted via ASE and cleaned up on an Envirogel column. HPLC-MS/MS analysis is carried out on an Agilent 1290 LC system coupled with a 6490 triple quadrupole mass spectrometer, similarly to what is described for sediment samples.

Preliminary results

First results show that more than 20 out of the 35 analysed PFAS can be detected in the seawater samples. The sum of the detected PFAS was in the high pg/L- to the low ng/L-range. Samples taken close to the discharge of rivers with high anthropogenic influence showed the highest concentrations. The replacement compound hexafluoropropylene oxide dimer acid (HFPO-DA) was detected in the majority of the samples, albeit in comparatively low concentrations.

Water samples for insecticides and their metabolites are currently being analyzed, first results are expected for Q1 2021. Similarly, for glyphosate and its main metabolite AMPA (aminomethylphosphonic acid) water samples are expected to be analyzed during the first half of 2021, after some improvements to the sample preparation method are made in order to lower the LOQ (Limit of Quantification) of the analytical method. Results for sediment will follow later in the year.

Preliminary results for UVAs and Parabens in water samples show only sporadic detection of some UVAs (BP-3, Octocrylene, EHMC) in the area of <LOQ - low ng/L. Sediment and bulk plankton samples are to be analyzed in the first half of 2021.

5.3 Profiling the Vertical Transport of Microplastics in the Western European Coast

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Background and Objectives

This study aims to provide information about microplastics (MP) vertical distribution and concentrations along Western European coastal areas. More specifically, the relation between plastic concentration in sea surface and water column and the plastic settled in sediments. It also aims to search the influence of sedimentation rates, proximity to anthropogenic activities, and disturbance regimes on microplastic distribution between sites and within the sediment column. An understanding of the distribution and accumulation of this form of pollution is crucial for gauging environmental risk. The MP characterization, distribution and concentrations will also provide the environmental context for understanding interactions between microplastics and marine organisms. Therefore, the development, improvement, and validation of methods for the analysis of microplastics will provide a comprehensive and systematic picture on the degree of contamination and distribution of microplastics in the ocean.

Methods

During AL534/2, sediment samples were collected using a compact sediment corer Mini Muc at 8 stations (station details in Section 6). The top sediment cores were sliced in 5 cm thickness layers and stored in glass jars at 4°C for further analysis.

Seawater samples were collected from three different depths using Niskin bottles mounted on a traditional CTD at 5 stations (station details in Section 6). For monitoring microplastics, 1 L of each sample was filtered onto polycarbonate membrane filters (20 µm pore size) and stored at -20ºC for later analysis at home laboratory.

Sampling microplastics on the ocean surface and in water column usually includes trawling with different plankton nets. In general, nets allow for screening large volumes of water that increases the success of microplastic particles collecting. Thus, neuston catamarans and bongo nets were deployed along the cruise to collect horizontal and obliquely tows, respectively. Each catamaran tow lasted 20 minutes and a total of 37 samples were collected in 13 stations, using three tow per station except for station 29 where only 1 tow was made (station details in Section 6). For neuston tows, the volume of water sampled will be estimated by multiplying the tow length by the area of the submerged opening. A total of 42 bongo samples were collected at 14 stations with triplicates and trawls were conducted over 30 minutes (station details in Section 6). A flowmeter was mounted at one bongo net opening for further water flow calculations, enabling the calculation of concentrations of microplastics per water volume. After each tow, nets were washed and rinsed on board, and the content of cod-ends was transferred to aluminum containers and transported to the laboratory. Samples were washed and homogenized using filtered seawater and a metal sieve (100 µm), split in two and the half part reserved for microplastic analysis using a destructive protocol was frozen at -20ºC until subsequent analysis on land. All plastic particles larger than 5 mm found, were photographed, and reserved for analysis as a potential fragmentation source of microplastics. To avoid contamination, aluminum containers were rinsed with filtered seawater and maintained closed before and after the sampling. Nets and cod-ends were also decontaminated before used in the next sampling. After each sampling cleaned code-ends were attached and the trawl was rinsed from the outside with seawater to assess the carryover of microplastics between samples. Likewise, subsamples of potential contamination sources from the vessel were taken.

Work to be conducted in home laboratory

Microplastic extractions from sediment and nets samples will be performed following the protocols described by Gago et al. (2019) and Frias et al. (2018). Briefly, sediment samples will be freeze-dried to reduce cohesiveness of the sediment matrix and treated with a solution of sodium tungstate dihydrate ($Na_2WO_4 \cdot 2H_2O$ – density: 1.4 – 1.6 g.cm^{-3}). Subsequently, the overlying solution will be collected and filtrated. Bongo and neuston nets samples are usually composed by high amounts of phytoplankton, amphipods, and gastropods, being difficult to process directly. In this sense, 10% potassium hydroxide (KOH) solution prepared in ultrapure water will be added at 1:3 (volume sample: volume solution) to digest the biological material during 48h at 40ºC and filtered. Following this step, if all organic matter was not digested, an additional step using hydrogen peroxide (15%) will be added. Filter will be visualized using a stereomicroscope LEICA S9i (Leica Microsystems GmbH, Wetzlar, Germany) coupled with a IC80 HD camera. Potential microplastics will be photographed and sorted into categories related to shape, color, longest length, and perpendicular width. Likely, all plastic pieces larger than 5 mm collected within Neuston samples will be visual characterized. Plastic particles will be identified according their chemical composition by Fourier Transform Infrared Spectrometry (FTIR) using a PerkinElmer Spotlight 200i FTIR Imaging System equipped with a mercury cadmium telluride (MCT) array detector cooled by liquid nitrogen. Spectra will be collected in reflectance mode with a measurement resolution of 4 cm^{-1} in the range of between 4000 cm^{-1} and 600 cm^{-1} with a minimum of 10 scans. To confirm the polymer type, all spectra will be compared to library databases and then by comparison analysis of the polymer characteristic bands with spectra assignments. The laboratory work will be performed within the following year and a half.

5.3 Sediment sampling with multiple and box corer for microplastics quantification

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Background and Objectives

The HOTMIC project aims at the quantification of lateral and vertical transport processes and the distribution of microplastic particles from the coast to the open ocean and from the sea surface to the seafloor. Seafloor sediments are expected to be the final sink of microplastic particles in the marine environment, where they get buried over geological time scales. We deployed different coring devices (mini multi corer (MIC), mini box corer (BC) and van Veen grab (VGRAB)) during the cruise in order to collect sediment samples for subsequent microplastics extraction, quantification and spectroscopic identification. One additional core per station was collected for geochemical analyses (major cations and anions, POC, $CaCO_3$, PON, S, porosity, ^{210}Pb). This data will be used for a general biogeochemical characterization of the sediments, including mixing of surface sediments due to bioturbation.

Methods

Van Veen grab

The van Veen grab was used to recover semi disturbed sediment samples from the seafloor. It was lowered into the sediment with a rope speed of 0.5 m/s. Van Veen grab samples were processed by University of Ghent and Köln University.

Mini multiple corer

The MIC is equipped with 4 Perspex liners with an internal diameter of 9.5 cm and was used to sample undisturbed sediment cores including the overlying bottom water. It was lowered into the sediment with a rope speed of 0.3 m/s and once on the seafloor the liners were pushed into the sediment under gravity by a piston with attached lead weights (an additional weight of ~80 kg). Recovered cores had a length of 9 to 23 cm, depending on the sediment type. The cores were sampled on board and the samples were stored for land-based analyses. For geochemical analyses, full cores were sampled and the sectioning had a depth resolution of 1 cm for the top 10 cm of the core and 2 cm for deeper parts. For microplastics analyses, the core was cut into up to 4 subsequent sections of 3-cm thickness. MIC liners from 10 different stations were processed.

Mini box corer

The mini box corer was used to recover an undestroyed sediment surface sample from the ocean floor. It was lowered into the sediment with a rope speed of 0.5 m/s. Sediment cores for further processing were sub-sampled with MIC liners. Sampling of the cores followed the procedure described above for the MIC. The box corer was deployed when coring with the MIC was not successful due to relatively compact sediments. This occurred at stations 2, 29 and 31. Stations 2 and 29 were located in regions with relatively high bottom currents and only some hard debris could be recovered. At station 31, sediment retrieval with the box corer was successful and could be sampled. Because of strong water currents, no MIC and BC coring was possible at station 41 in the river Elbe.

Preliminary results

Figures 5.2 and 5.3 show the results of the on shore geochemical analyses of the pore water and the sediment phase. The curves differ individually and represent the different locations of the sampling sites.

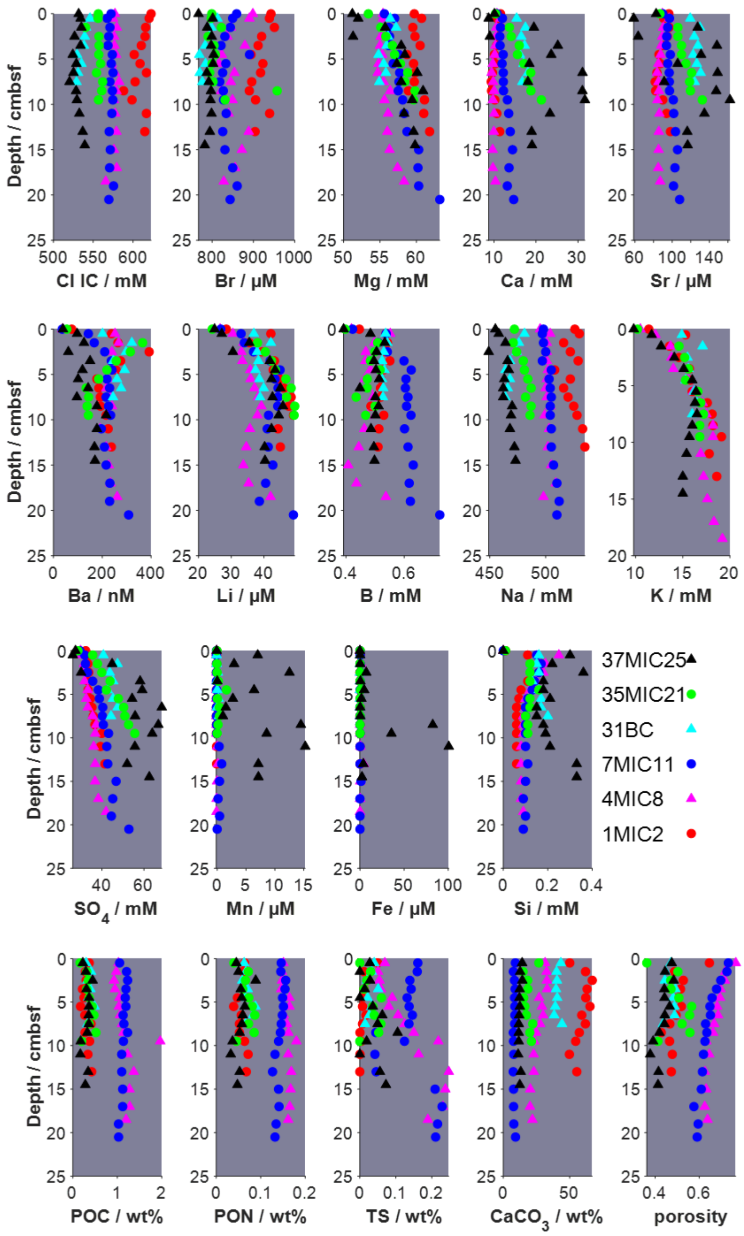

Figure 5.2: Results of geochemistry analyses for cores 1MIC2 to 37MIC25. Rows 1-3: pore water analyses; row 4: sediment analyses.

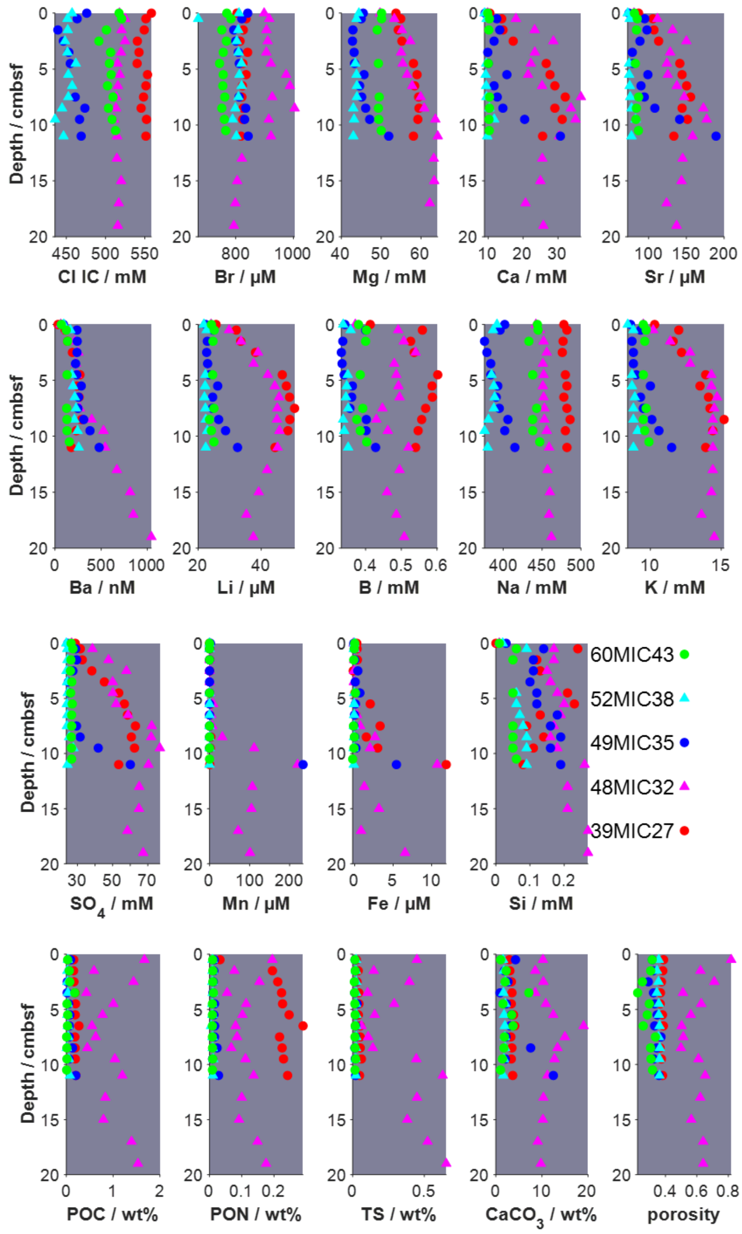

Figure 5.3: Results of geochemistry analyses for cores 39MIC27 to 60MIC43. Rows 1-3: pore water analyses; row 4: sediment analyses.

Work to be conducted in home laboratory

Shore-based analyses include geochemical analyses and microplastics quantification. The following analyses are already completed: Sediment porosities were calculated from weight difference before and after freeze-drying. Porewater from the sediments was extracted with rhizones and analyzed for major anions and cations using ICP-AES and IC, respectively. Particulate organic carbon and nitrogen, total sulfur and $CaCO_3$ contents of the solid phase were determined by complete and instantaneous oxidation of the freeze-dried, grounded and homogenized sample and subsequent chromatographic identification of the combustion products. Results are presented in Figures 5.2 and 5.3. Isotope analyses of the solid phase are planned for 2021 and will be used for modeling of the bioturbation process.

Sediment samples for microplastic quantification were dried to avoid strong microbial degradation and fouling during storage. As a next step, microplastic particles will be extracted by density separation and filtering using an established protocol and Raman spectroscopy will be used for polymer identification. This work is planned for the second half of 2021.

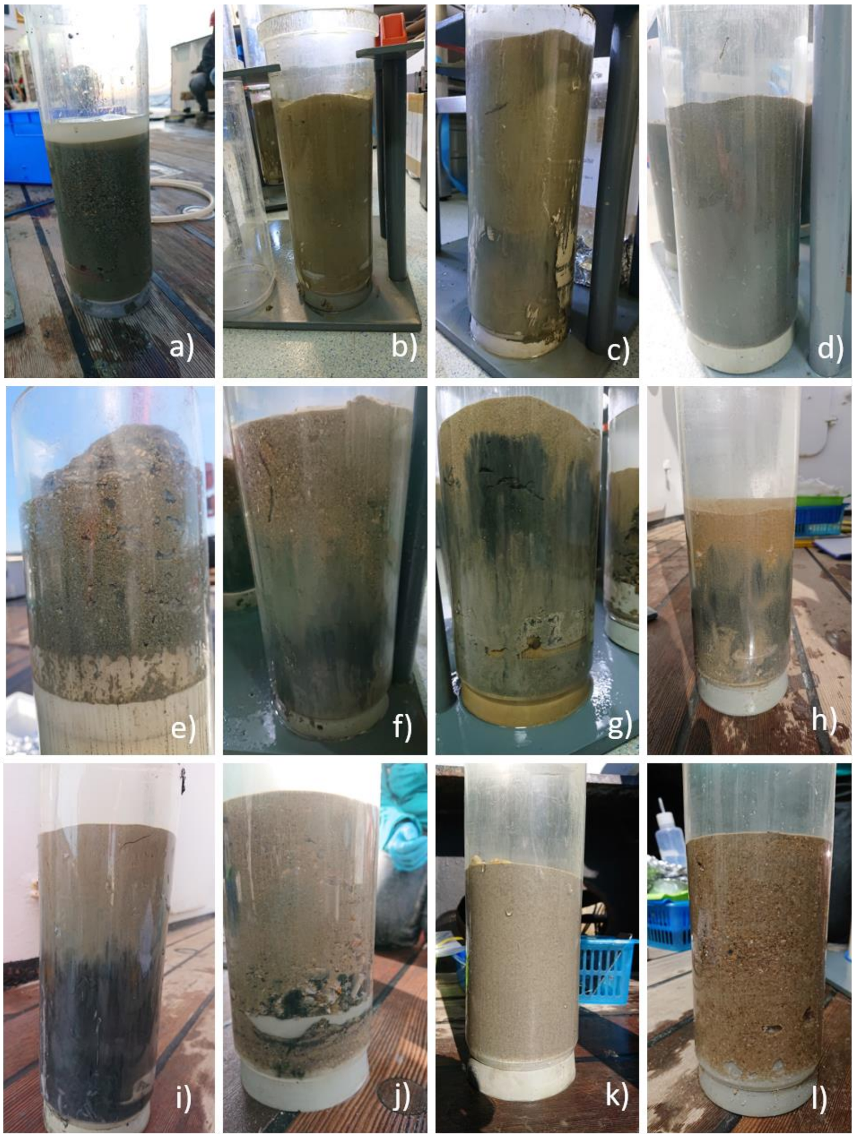

Figure 5.4: MIC sediment cores from AL534_2 stations (a) – d) and f) – l)) and stamp out from a box core (e)). a): 1MIC2, b) 4MIC8, c) 7MIC11, d) 17MIC15, e) 31BC, f) 35MIC21, g) 37MIC21, h) 39MIC27, i) 48MIC32, j) 49MIC35, k) 52MIC38, l) 60MIC43.

5.4 Abundance and composition of microplastic in gelatinous zooplankton

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Background and objectives

Our main objective is to measure the abundance and composition of microplastic (MP) associated with gelatinous zooplankton and to assess the role of gelatinous zooplankton in transporting MP across marine food webs. Gelatinous zooplankton were collected along different sampling locations during cruise AL534-2. We provide an overview of the gelatinous zooplankton species composition, abundance and size structure at each sampling location and quantify microplastic contaminations on inner and outer morphological structures (e.g. umbrella, tentacles, gastrovascular system) of examined specimen.

Methods

Gelatinous zooplankton was sampled during March 2020 on board R/V "ALKOR" (AL534-2) at 15 different sampling locations using depth-integrated vertical hauls with a 2 mm-meshed ring net (net area A_{net} = 1.77 m²; ship speed: 0 knots; n = 3 per sampling location) or horizontal tows with a 300 µm-meshed bongo net (A_{net} = 0.26 m²; ship speed: 1-3 knots; depth ~10 m; n = 3 per sampling location). After each net haul, blank net samples were obtained after rinsing with sea water to control for MP contamination of samples from the net gaze. All samples were transferred to metal or glass containers for further processing to reduce the level of MP contamination. For vertical and horizontal samplings, haul lengths (L_{haul}, m) were determined from the sampling depth or using a digital flowmeter (HYDRO BIOS, model 438115, 0.3 m per revolution), respectively. Sampled water volumes (V , m³) were estimated as

$$V = A_{net} \times L_{haul} \qquad \text{Eq. 1}$$

Gelatinous zooplankton samples were immediately processed in the ship-laboratory for taxonomic identification of species based on morphology (Bouillon et al. 2006, Holst & Laakmann 2014, Jarms et al. 2019, Russell 1953, Marine Species Identification Portal). Selected specimens were preserved in 99 % ethanol for molecular species identification. We counted the number of individuals (I, ind.) of each species per net haul and measured their individual size (n = 10 ind.), i.e. oral-aboral length (L, mm) or inter-rhopalia diameters (d, mm), respectively. The abundance (N, ind. m^{-3}) of each species was estimated using the equation

$$N = \frac{I}{V} \qquad \text{Eq. 2}$$

Abundant species were examined for visible MP contaminations using a stereo microscope with integrated video camera (LEICA EZ4W). Replicate specimen (n ≤ 6 ind. per net haul and species) were transferred to glass jar and immediately freeze dried (−50 °C, 0.2 mbar; LABCONCO FreeZone) for at least 12 hours. Comparative blank container samples with filtered (0.2 µm) seawater (1 mL, n = 3 per sampling location) were freeze dried to exclude environmental MP contamination during sample preparation.

Preliminary results

Gelatinous zooplankton communities along the transect of AL534-2 were represented by members of cnidaria, ctenophores, tunicates and chaetognathes (Fig. 5.5). Various hydromedusae (Cnidaria), such as the trachymedusa *Liriope* sp., the leptomedusa *Obelia* sp. or the siphonophore *Velella velella* with umbrella diameters ranging from 3 to 19 mm and abundances ≤0.8 ind. m^{-3} were present in the Mediterranean Sea and North Atlantic (locations #1-5) along with salps, e.g. *Salpa fusiformis* (Tunicata, Thaliacea; Table 2). Arrow worms (Chaetognatha, Sagittoidea) dominated the gelatinous zooplankton in parts of the English Channel and North Sea (locations #6-9) with abundances up to 13 ind. m^{-3}. The ctenophore *Pleurobrachia* sp. (Tentaculata) was observed at most sampling locations along the transect (all locations except #1 and #11), reaching abundances ≤1 ind. m^{-3} and a maximum length of 11 mm. *Mnemiopsis leidyi* (Ctenophora, Tentaculata) and *Beroe* sp. (Ctenophora, Nuda) were only present in the German Bight (locations #12-16) at abundances <0.1 ind. m^{-3} and maximum lengths of 30 or 43 mm, respectively. Larger scyphomedusae (Cnidaria), including *Aurelia aurita*, *Cyanea capillata* and *C. lamarckii* with diameters of 42 or 49 mm, respectively, were present (≤1.3 ind. m^{-3}) in the North Sea (Table 2, Fig. 5.5). In several cases, we observed artificial fibers and particles associated with the outer and inner morphological structures of collected gelatinous organisms, i.e., on the subumbrella and in the gastric pouch of medusae or on the combs of ctenophores, respectively (Fig. 5.6).

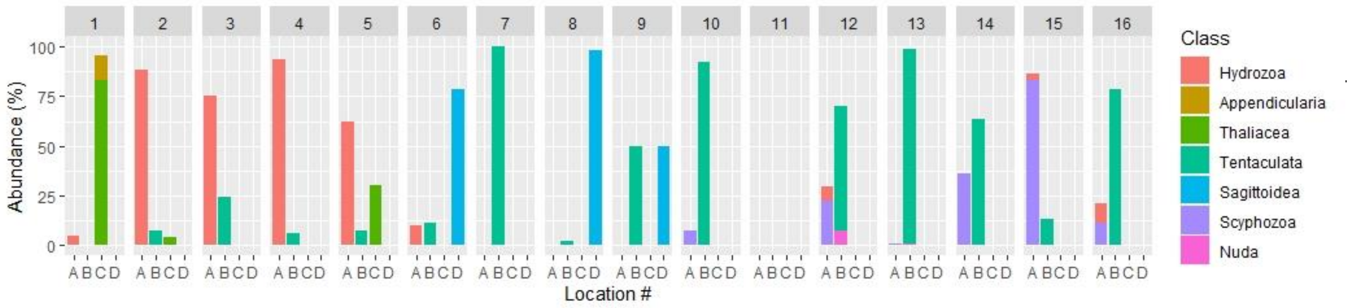

Figure 5.5: Gelatinous zooplankton (GZ) composition along different sampling locations (#1-16) during cruise AL534-2. Represented phyla are indicated by capital letters (A: Cnidaria, B: Ctenophora, C: Tunicata, D: Chaetognatha).

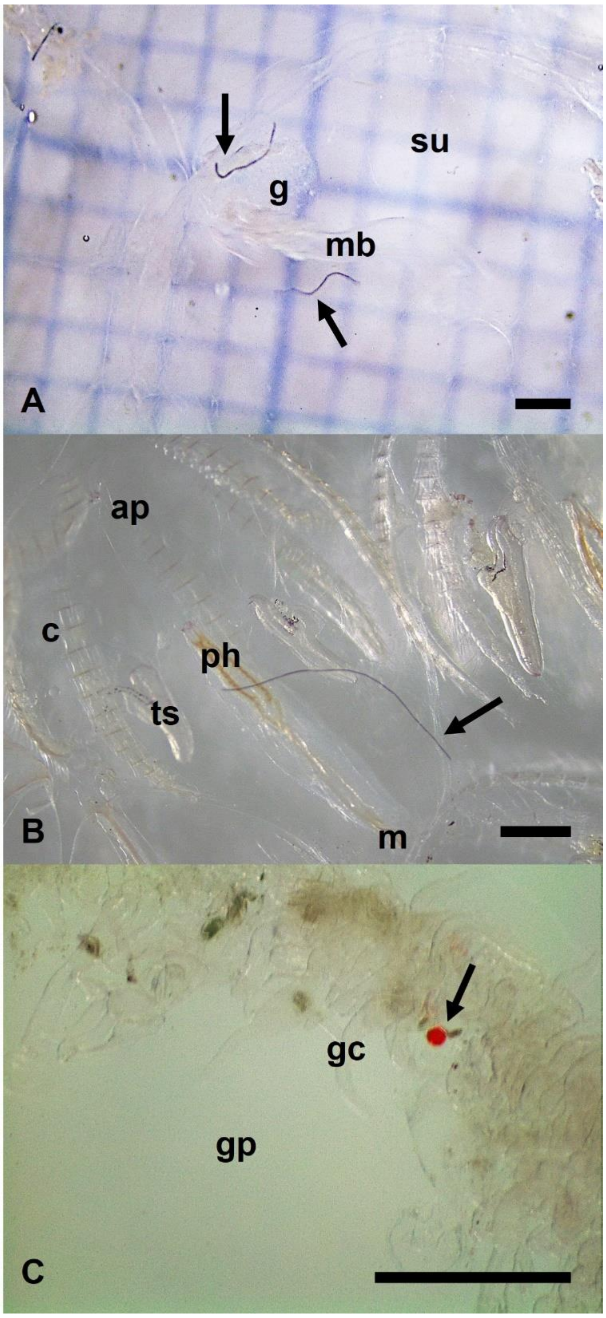

Figure 5.6: Artificial particles (arrows) associated to outer and inner morphological structures of gelatinous zooplankton. (A) Fibers attached to the subumbrella (su) of the hydromedusa *Liriope* sp. (location #4; mb: manubrium, g: gonad), (B) fibers attached to the outer surface of the ctenophore *Pleurobrachia* sp. (location #3; m: mouth, ph: pharynx, ap: anal pore, c: comb, ts: tentacle sheet with tentacle), (C) red (microplastic?) particle caught in the gastric cirri (gc) of the scyphomedusa *Aurelia* sp. (location #12; gp: gastric pouch).

Work to be conducted in home laboratory

Subsequent in-depth analysis of the samples collected during AL534-2 will include measurement of the abundance and composition of MP associated with gelatinous zooplankton. For this purpose, freeze-dried samples will be digested in 10 % KOH at 40 °C to remove organic material and the remaining MP will be collected on stainless steel filters (8 µm) for identification, quantification and characterization using microscopy and Raman spectroscopy (Anger et al. 2018). Selected gelatinous zooplankton species will be identified based on DNA barcoding.

Table 2. Abundance of gelatinous zooplankton along different sampling locations during AL534-2 (#1: 36°25,690' N, 04°49,701' W; #2: 35°59,924' N, 05°54,363' W; #3: 36°51,998' N, 08°38,098' W; #4: 38°32,389' N, 09°18,029' W; #5: 43°41,106' N, 05°43,508' W; #6: 49°57,082' N, 01°43,038' W; #7: 49°24,184' N, 00°04,559' W; #8: 51°29,304' N, 01°40,631' E; #9: 51°28,254' N, 03°00,350' E; #10: 53°39,631' N, 05°12,181' E); #11: 53°52,248' N, 09°15,025' E; #12: 54°05,163' N, 08°05,015' E; #13: 53°59,338' N, 08°28,811' E; #14: 53°52,485' N, 06°16,762' E; #15: 53°32,507' N, 06°41,519' E; #16: 53°53,118' N, 08°06,079' E. *L*: haul length (asterisks mark horizontal bongo net tows), *V*: sampled water volume (Eq. 1), *d/L*: inter-rhopalia diameter (cnidaria) or oral-aboral length (ctenophores, tunicates, chaetognaths), respectively; *I*: individual number; *N*: abundance (Eq. 2), n.d.: not determined. Means (±SD) are shown.

Location # /Date	*L* (m)	*V* (m³)	Phylum	Class	Order	Species*	*d/L* (mm)	*I* (ind.)	*N* (ind. m^{-3})	*N* (%)
1	100±0	177±0	Cnidaria	Hydrozoa	Anthoathecata	*Amphinema rubra*	4.0±0	1±0	0.006±0	1.1
06 March	100±0	177±0				*Rathkea octopunctata*	10.0±0	1±0	0.006±0	1.1
2020	100±0	177±0			Siphonophora	n.d.	18.5±2.1	2±0	0.011±0	2.1
	100±0	177±0		Scyphozoa	Semaeostomeae	*Pelagia noctiluca*	23.1±18.6	5±1	0.026±0.008	5.0
	100±0	177±0	Tunicata	Appendicularia	n.d.	n.d.	7.4±1.0	11±0	0.062±0	11.8
	100±0	177±0		Thaliacea	Salpida	*Pegea confoederata*	22.2±5.1	9±3	0.052±0.015	9.9
	100±0	177±0				*Salpa fusiformis*	26.2±19.5	59±19	0.331±0.108	62.9
	100±0	177±0				*Soestia zonaria*	46.5±7.9	6±2	0.032±0.010	6.0
2	100±0	177±0	Cnidaria	Hydrozoa	Anthoathecata	*Bougainvillia* sp.	8.8±2.1	4±0	0.023±0	8.7
07 March	100±0	177±0				*Coryne* sp.	13.0±0	1±0	0.006±0	2.3
2020	100±0	177±0				*Neoturris pileata*	7.0±0	1±0	0.006±0	2.3
	100±0	177±0			Leptothecata	*Clytia* sp.	22.0±0	1±0	0.006±0	2.3
	100±0	177±0				*Obelia* sp.	7.3±3.2	2±1	0.013±0.006	4.8
	100±0	177±0			n.d.	n.d.	5.0±0	1±0	0.006±0	2.3
	100±0	177±0			Siphonophora	*Lensia* sp.	3.5±0.7	8±0	0.045±0	17
	100±0	177±0				*Muggiaea atlantica*	4.6±2.4	6±2	0.036±0.011	13.7
	100±0	177±0			Trachymedusae	*Liriope* sp.	6.3±1.6	16±11	0.092±0.062	34.6
	100±0	177±0		Scyphozoa	Semaeostomeae	*Pelagia noctiluca*	4.0±0	1±0	0.006±0	7.4
	100±0	177±0	Ctenophora	Tentaculata	Cydippida	*Pleurobrachia* sp.	5.4±7.6	3±1	0.020±0.008	0.8
	1618±0	428±0*	Mollusca	Gastropoda	Pterotracheidea	n.d.	102±0	1±0	0.002±0	4.1
	100±0	177±0	Tunicata	Thaliacea	Salpida	*Soestia zonaria*	20.5±6.4	2±0	0.011±0	4.1

Table 2. continued

Location # /Date	*L* (m)	*V* (m^3)	Phylum	Class	Order	Species*	*d*/*L* (mm)	*I* (ind.)	*N* (ind. m^{-3})	*N* (%)
3	100±0	177±0	Cnidaria	Hydrozoa	Anthoathecata	*Euphysora* sp.	6.7±1.2	8±5	0.043±0.028	4.3
08 March	100±0	177±0			Leptothecata	*Obelia* sp.	10.8±2.5	16±6	0.091±0.032	9.3
2020	100±0	177±0			Siphonophora	*Bassia bassensis*	4.1±1.7	11±1	0.064±0.007	6.5
	100±0	177±0				*Muggiaea atlantica*	4.6±0.8	43±11	0.242±0.061	24.6
	100±0	177±0				*Nectopyramis* sp.	6.0±0	1±0	0.006±0	0.6
	100±0	177±0			Trachymedusae	*Liriope* sp.	7.8±2.2	52±18	0.296±0.101	30.1
	100±0	177±0	Ctenophora	Tentaculata	Cydippida	*Pleurobrachia* sp.	4.9±1.3	43±5	0.242±0.027	24.6
4	100±0	177±0	Cnidaria	Hydrozoa	Anthoathecata	*Sarsia eximia*	6.0±0	1±0	0.006±0	0.5
10 March	100±0	177±0			Leptothecata	*Obelia* sp.	8.7±2.9	34±14	0.192±0.078	14.8
2020	100±0	177±0			Siphonophora	*Muggiaea atlantica*	4.4±0.5	32±14	0.181±0.082	14.0
	100±0	177±0				n.d.	3.0±0	1±0	0.006±0	0.5
	100±0	177±0			Trachymedusae	*Liriope* sp.	7.2±2.4	147±72	0.834±0.407	64.1
	100±0	177±0	Ctenophora		Cydippida	*Pleurobrachia* sp.	4.0±1.3	14±4	0.080±0.020	6.2
5	80±0	141±0	Cnidaria	Hydrozoa	Anthoathecata	*Ectopleura* sp.?	3.7±1.2	3±0	0.021±0	7.9
12 March	61±20	107±36			Leptothecata	*Obelia* sp.	5.6±2.1	15±4	0.146±0.039	54.7
2020	55±21	97±37	Ctenophora	Tentaculata	Cydippida	*Pleurobrachia* sp.	3.9±1.1	2±0	0.020±0.009	7.5
	80±0	141±0	Tunicata	Thaliacea	Salpida	*Pegea confoederata*	35.0±0	1±0	0.007±0	2.6
	69±19	121±33				*Salpa fusiformis*	13.9±7.4	9±7	0.073±0.041	27.3
6	2237±0*	591±0	Cnidaria	Hydrozoa	Anthoathecata	*Velella velella*	3.0±1.4	2±0	0.003±0	10.1
17 March	2409±252	636±67	Ctenophora	Tentaculata	Cydippida	*Pleurobrachia* sp.	11.0±9.3	2±1	0.003±0.002	11.4
2020	40±0	71±0	Chaetognatha	Sagittoidea	Aphragmophora	*Sagitta* sp.	11.0±2.6	2±1	0.023±0.008	78.5
7 18 March 2020	1402±20*	370±5	Ctenophora	Tentaculata	Cydippida	*Pleurobrachia* sp.	5.0±1.1	12±3	0.031±0.009	100.0
8	1733±0*	458±0	Ctenophora	Tentaculata	Cydippida	*Pleurobrachia* sp.	9.0±0	1±0	0.002±0	1.9
19 March 2020	20±0	35±0	Chaetognatha	Sagittoidea	Aphragmophora	*Sagitta* sp.	13.3±1.2	4±2	0.106±0.049	98.1
9	10±0	18±0	Ctenophora	Tentaculata	Cydippida	*Pleurobrachia* sp.	4.0±1.4	1±0	0.057±0	50.0
19 March 2020	10±0	18±0	Chaetognatha	Sagittoidea	Aphragmophora	*Sagitta* sp.	12.0±0	1±0	0.057±0	50.0

Table 2. continued

Location # /Date	*L* (m)	*V* (m^3)	Phylum	Class	Order	Species*	*d*/*L* (mm)	*I* (ind.)	*N* (ind. m^{-3})	*N* (%)
10	20±0	35±0	Cnidaria	Scyphozoa	Semaeostomeae	*Cyanea* sp.	49.0±0	1±0	0.028±0	7.5
20 March 2020	20±0	35±0	Ctenophora	Tentaculata	Cydippida	*Pleurobrachia* sp.	3.7±2.1	12±3	0.345±0.088	92.5
11										
23 March 2020	-	-	-	-	-	-	-	-	-	-
12	10±0	18±0	Cnidaria	Hydrozoa	Leptothecata	*Aequorea vitrina*	49.0±0	1±0	0.057±0	7.2
24 March 2020	10±0	18±0		Scyphozoa	Semaeostomeae	*Cyanea* sp.	8.0±2.6	3±0	0.170±0	21.3
	1784±38*	471±10				*Aurelia* sp.	41.9±11.4	4±1	0.010±0.003	1.2
	10±0	18±0	Ctenophora	Nuda	Beroida	*Beroe* sp.	43.0±0	1±0	0.057±0	7.2
	10±0	18±0	Ctenophora	Tentaculata	Cydippida	*Pleurobrachia* sp.	3.7±2.5	8±2	0.476±0.135	59.7
	1752±11*	463±3			Lobata	*Mnemiopsis leidyi*	31.2±6.7	13±6	0.028±0.014	3.5
13	591±0*	156±0	Cnidaria	Scyphozoa	Semaeostomeae	*Cyanea* sp.	32.0±0	1±0	0.006±0	0.5
24 March 2020	553±55*	146±15				*Aurelia* sp.	39.0±18.2	1±0	0.007±0.001	0.6
	471±0*	124±0	Ctenophora	Nuda	Beroida	*Beroe* sp.	23.0±0	1±0	0.008±0	0.7
	10±0	18±0	Ctenophora	Tentaculata	Cydippida	*Pleurobrachia* sp.	5.4±2.7	17±5	0.981±0.267	88.0
	10±0	18±0			Lobata	*Mnemiopsis leidyi*	23.5±4.2	2±0	0.113±0	10.1
14	20±0	18±0	Cnidaria	Scyphozoa	Semaeostomeae	*Cyanea* sp.	25.1±17.6	4±1	0.226±0	36.3
25 March 2020	20±0	18±0	Ctenophora	Tentaculata	Cydippida	*Pleurobrachia* sp.	5.2±3.7	7±3	0.396±0.179	63.7
15	10±0	18±0	Cnidaria	Hydrozoa	Anthoathecata	*Sarsia tubulosa*	4.0±0	1±0	0.057±0	3.7
25 March 2020	10±0	18±0		Scyphozoa	Semaeostomeae	*Cyanea* sp.	7.4±3.1	22±6	1.257±0.339	82.4
	555±0*	147±0				*Aurelia* sp.	29.0±0	1±0	0.007±0	0.5
	10±0	18±0	Ctenophora	Tentaculata	Cydippida	*Pleurobrachia* sp.	4.8±0.8	3±1	0.147±0.031	9.7
	10±0	18±0			Lobata	*Mnemiopsis leidyi*	28.0±0	1±0	0.057±0	3.7
16	10±0	18±0	Cnidaria	Hydrozoa	Anthoathecata	*Sarsia tubulosa*	4.0±0	1±0	0.057±0	4.9
26 March 2020	10±0	18±0			Leptothecata	*Obelia* sp.	6.0±0	1±0	0.057±0	4.9
	10±0	18±0		Scyphozoa	Semaeostomeae	*Cyanea* sp.	10.7±3.3	2±1	0.132±0.046	11.4
	10±0	18±0	Ctenophora	Tentaculata	Cydippida	*Pleurobrachia* sp.	5.7±2.3	16±4	0.905±0.205	77.8
	820±27*	217±7			Lobata	*Mnemiopsis leidyi*	30.4±4.4	3±1	0.012±0.003	1.0

*To be confirmed

5.5 Vertical distribution of microplastics within shallow sediments and benthic fauna along the Atlantic coast

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Background and Objectives

The presence of microplastics (MPs) in the marine environment is now considered ubiquitous, since they have been recorded from surface waters to sediments, from coastal areas to deep sea bottom, and from fish tissues to zooplankton guts (Andrady 2011; Nelms et al. 2018; Filgueiras 2019; Pohl et al. 2020). The effects of plastics on ecosystem functioning have been investigated in a number of studies, yet there are still gaps in knowledge to be filled, especially concerning the benthic intake of MPs and possible consequences (Fueser et al. 2019). The inevitable destiny of MP particles suspended in the water column is to eventually sink to the sea bottom, where they interact with the surrounding environment. Our main objective is to assess MPs distribution within the vertical profile of the seabed and couple it with the burial potential of benthic organisms. Moreover, we intend to identify and analyze the possible effects of MPs on benthos, as well as their potential influence on trophic relationships.

Methods

During the research cruise AL 534/2, a total of 16 stations were sampled along the Atlantic coast from Malaga (Spain) to Kiel (Germany) (Fig. 3.1). Both a van Veen Grab (VGRAB) and a mini-corer (MIC) were operated in order to obtain two types of sediment samples. Depending on sediment characteristics, a Box corer (BC) was used in substitution of the MIC when needed. Sampling techniques and deployment information are listed in Section 6.

The van Veen Grab was deployed three times at each station: for each deployment the sediment was collected in a bucket and sieved over a 1 mm sieve to wash away finer particles (Fig. 5.7a). Macrofauna specimens were picked out and stored in 8 % formaldehyde buffered with sea water.
Three cores from 3 different deployments were collected using a mini-multicorer at each station. Cores were washed prior to sampling to limit plastic contamination from the device. Overlying water was sieved over a 32 µm sieve and was subsequently added to Subsample 5 (see next paragraph). The first 10 cm of the cores were sliced into 1 cm slices (Fig. 5.7b). Because of the diverse nature of sediment types at different stations (thus different penetration of the device through the seafloor) it was not always possible to obtain slices up to 10 cm. All cores were sliced at least up to 7 cm. Each slice was positioned on Aluminum foil to limit contamination and divided into 5 subsamples.
Each subsample was stored according to the relative analysis to be performed. Specifically:

- Subsample 1 & 2: two 4 cm diameter rings were cut out and stored in Aluminum trays at -20 °C. The two metal rings were positioned in the inner portion of the slice to avoid contamination with the outer sediment (in contact with the plastic core during deployment). These subsamples will be each used for i) the quantification and characterization of microplastics (MPs) in the sediment and ii) the potential ingestion of MPs from meiofauna organisms;
- Subsample 3: a small portion of sediment was collected with a metal spatula, stored in scintillation vials and preserved at - 80 °C for the analysis of Chlorophyll *a*.

- Subsample 4: half of the remaining sediment was stored at - 20 °C in plastic bags for the analysis of other pigments, total organic matter (TOM) and sediment grain size;
- Subsample 5: the second half of the remaining sediment was stored in plastic containers with 8 % formaldehyde buffered with sea water. This sample will be used for the characterization of the meiofauna community structure.


a.


b.

Figure 5.7: a) van Veen Grab sample washing over 1 mm sieve; b) 1 cm slices from one core: preparation for subsampling on Al foil to avoid MPs contamination

Preliminary results
Because of COVID-19 restrictions and other limitations, results are not available yet.

Work to be conducted in home laboratory
Macrofauna specimens collected from the Van Veen grab will be identified at the binocular in the UGent laboratory. Community structure and diversity will be investigated at each station. Coupled

with the analysis of the vertical distribution of MPs within the sediment layers, the bioturbation potential of the macrofauna organisms will be used to evaluate the possible burial of MPs in the deeper layers of the sediment. Subsamples from the mini-corer will be used for several analysis:

- MPs will be extracted from subsamples 1 and 2, respectively from sediment and from meiofauna, counted and identified. These will provide i) the vertical profile of MPs within the sediment layers and ii) possible information on meiofauna ingestion of MPs.
- Environmental parameters will be analyzed from subsample 3 (vertical distribution of Chl *a*) and subsample 4 (vertical distribution of other pigments and TOM, sediment grain size information).
- Finally, meiofauna extracted from subsample 5 will be used to assess the community structure at each station.

All the above-mentioned data will help outlining the characteristics of the benthic ecosystem at each station and understand the interaction of MPs with the benthic habitat.

5.6 Adaptations of benthic foraminifera to hydrodynamic conditions on the European shelf

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Background and Objectives

Benthic foraminifera colonize a wide range of marine environments, including areas of increased water turbulence (e.g., intensified bottom currents). Several studies demonstrate the influence of increased current velocities on the assemblages of epibenthic foraminifera across all water depths (Linke and Lutze, 1993; Schönfeld, 2002; Jorissen et al., 2007 and references therein) Highly adapted opportunistic suspension feeders colonize exposed, elevated substrates as a unique ecological niche. The occupation of such habitats optimizes the uptake of food particles transported in the suspension load by strong bottom currents, giving these species a competitive advantage over other epibenthic organisms. The attached species are also preserved in the fossil record, but their embedding and the taphonomic processes are poorly understood.

The sediment samples collected during cruise AL534/2 will allow us to evaluate settling strategies and taphonomic processes, ultimately adding to ongoing efforts at the University of Cologne to establish a proxy for the reconstruction of hydrodynamic conditions in the past.

Methods

During AL534/2, 80 hard substrates between 14 and 260 m water depth were collected from the sediment surface at 13 stations. The van Veen Grab (VGRAB) was used as the primary device, a boxcorer (BC) was deployed at two stations (Table 1). The VGRAB allowed for the examination of the undisturbed surface. Smaller substrates were sampled using tweezers, while larger objects were sampled wearing nitrile gloves. The collected hard substrates mainly consist of bivalves and larger stones. The samples were preserved in denatured ethanol (< 90-90%) and stored at 8°C.

For sediment and faunal analysis, 11 sediment cores were taken using a mini multicorer (MIC). In 7 of 11 MICs 10 cm of sediment were recovered, minimal recovery was 7.5 cm (details in Section

6). The sediment cores were sliced every 1 cm; individual slices were collected in Kautex bottles, stained with Rose Bengal and cooled at 8°C.

Preliminary results

The first objects were already examined under the light microscope while on board. On a rounded pebble collected at station 2 in the Strait of Gibraltar, specimens of an attached *Cibicides* sp. and *Cibicidoides wuellerstorfi* could already be identified (Fig. 5.8). Detailed investigations are to be conducted at the University of Cologne.

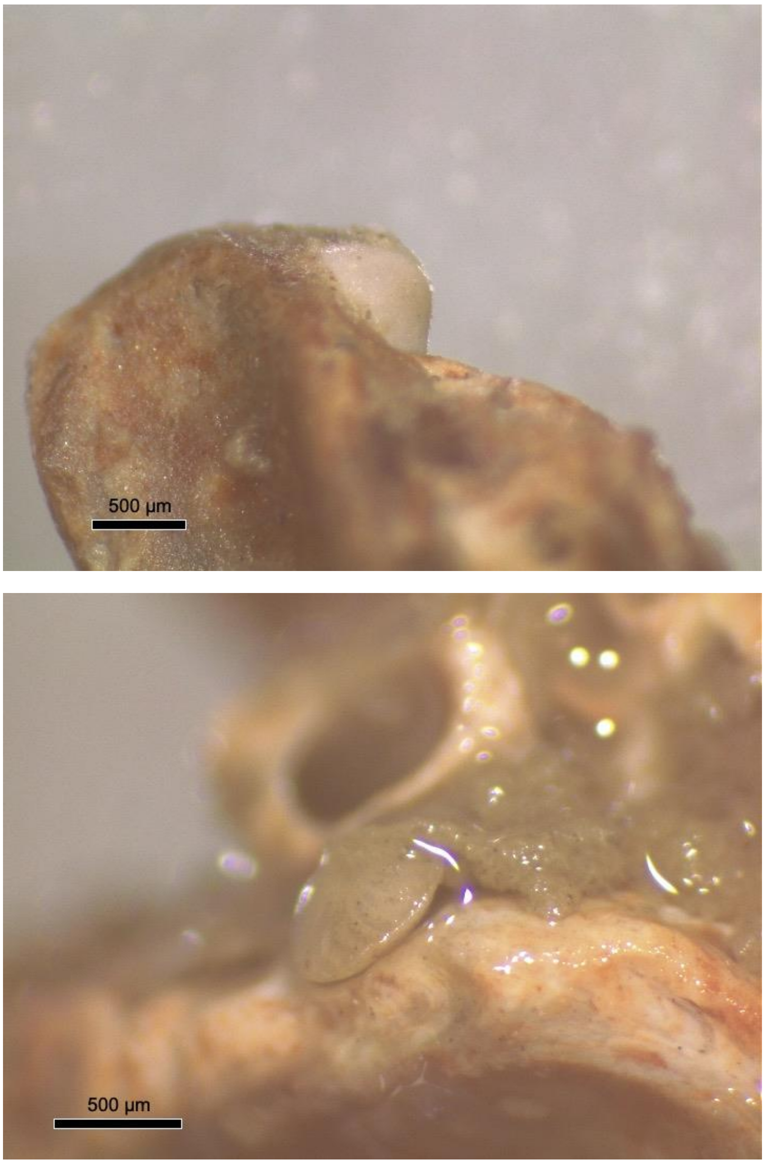

Figure 5.8: a) Attached *Cibicides* sp. on a collected pebble from the surface of the ocean floor in the Strait of Gibraltar with the VGRAB. b) *Cibicidoides wuellerstorfi* on the same stone as figure 9a.

Work to be conducted in home laboratory

The hard substrates obtained with the VGRAB and BC will initially be documented by using light microscopic and SEM techniques. Detailed comparative mappings to evaluate settling densities and patterns is planned for selected substrates.

The MIC samples will be prepared for further analyses in the coming months. Washed and dried sample residues > 63 µm will be used for faunal analyses of the MIC sediment samples.

6 Station List AL534/2

Deployment number	Date/Time	Gear	Latitude (°N)	Longitude (°W)		Depth (m)	Remarks
AL534/2_1-1	06.03.2020 13:58	CTD	36° 25.719	4° 49.749		155	Depths (m): 152.1, 129, 115, 99, 84.6, 54.3, 39.6, 29.2, 19.9, 9.7, 1.5
AL534/2_1-2	06.03.2020 14:15	van Veen Grab	36° 25.721	4° 49.738		155	
AL534/2_1-3	06.03.2020 14:31	van Veen Grab	36° 25.722	4° 49.724		155	
AL534/2_1-4	06.03.2020 14:43	van Veen Grab	36° 25.727	4° 49.704		154	
AL534/2_1-5	06.03.2020 14:57	Mini Corer	36° 25.719	4° 49.702		155	
AL534/2_1-6	06.03.2020 15:24	Mini Corer	36° 25.703	4° 49.704		157	
AL534/2_1-7	06.03.2020 15:47	Mini Corer	36° 25.693	4° 49.704		158	
AL534/2_0_Underway-2	06.03.2020 15:50	Thermosalinograph	36° 25.692	4° 49.706		158	
AL534/2_1-8	06.03.2020 16:40	WP3	36° 25.690	4° 49.701		158	
AL534/2_1-9	06.03.2020 16:55	WP3	36° 25.695	4° 49.702		157	
AL534/2_1-10	06.03.2020 17:09	WP3	36° 25.735	4° 49.688		154	
AL534/2_1-11	06.03.2020 17:33	Bongo Net	36° 25.739	4° 49.588		154	Haul length (m): 793.8 Volume (m3): 224.4 Sampling depth (m): 60
AL534/2_1-12	06.03.2020 18:20	Bongo Net	36° 25.729	4° 49.465		155	Haul length (m): 1118.7 Volume (m3): 316.3 Sampling depth (m): 45
AL534/2_1-13	06.03.2020 18:45	Bongo Net	36° 25.764	4° 49.549		151	Haul length (m): 1120.5 Volume (m3): 316.8 Sampling depth (m): 40
AL534/2_2-1	07.03.2020 07:02	CTD	35° 59.827	5° 54.318		179	Depths (m): 173.9, 148.6, 99.1, 80.2, 58.6, 49.5, 39.2, 28.9, 19.3, 9
AL534/2_2-2	07.03.2020 07:17	van Veen Grab	35° 59.828	5° 54.321		180	empty
AL534/2_2-3	07.03.2020 07:25	van Veen Grab	35° 59.824	5° 54.324		179	empty
AL534/2_2-4	07.03.2020 07:41	Mini Corer	35° 59.833	5° 54.370		181	empty
AL534/2_2-5	07.03.2020 07:56	Mini Corer	35° 59.863	5° 54.383		180	empty
AL534/2_2-6	07.03.2020 08:14	Box Corer	35° 59.897	5° 54.374		180	only stones/gravel and shells recovered
AL534/2_2-7	07.03.2020 08:33	WP3	35° 59.924	5° 54.363		180	
AL534/2_2-8	07.03.2020 08:47	WP3	35° 59.979	5° 54.412		182	
AL534/2_2-9	07.03.2020 09:00	WP3	36° 00.011	5° 54.428		183	

AL534/2_2-10	07.03.2020 09:20	Bongo Net	35° 59.855	5° 54.314		180	Haul length (m): 2591.1 Volume (m3): 732.6 Sampling depth (m): 30
AL534/2_2-11	07.03.2020 10:54	Bongo Net	35° 59.966	5° 54.210		179	Haul length (m): 1928.4 Volume (m3): 545.2 Sampling depth (m): 40
AL534/2_2-12	07.03.2020 11:41	Bongo Net	35° 59.855	5° 53.804		178	Haul length (m): 1617.9 Volume (m3): 457.5 Sampling depth (m): 45
AL534/2_2-13	07.03.2020 12:21	Neuston-Schlitten	35° 59.889	5° 52.444		213	Net area:0.1346 m^2
AL534/2_2-14	07.03.2020 12:44	Neuston-Schlitten	35° 59.823	5° 53.555		181	Net area:0.1346 m^2
AL534/2_2-15	07.03.2020 13:09	Neuston-Schlitten	35° 59.775	5° 54.751		189	Net area:0.1346 m^2
AL534/2_2-16	07.03.2020 14:00	In Situ Pump	35° 59.791	5° 55.806		191	Pump depths: 30, 60 m
AL534/2_2-17	07.03.2020 14:16	Underway Water Sampling	35° 59.798	5° 55.809		191	
AL534/2_3-1	07.03.2020 21:42	Underway Water Sampling	36° 01.158	6° 17.457		99	
AL534/2_4-1	08.03.2020 11:01	CTD	36° 51.818	8° 38.038		252	Depths (m): 243.5, 217.2, 190.8, 159.4, 140, 117.8, 97.8, 80.6, 58.2, 39.3, 19.4, 2.3
AL534/2_4-2	08.03.2020 11:16	van Veen Grab	36° 51.847	8° 38.041		253	
AL534/2_4-3	08.03.2020 11:47	van Veen Grab	36° 51.931	8° 38.019		246	
AL534/2_4-4	08.03.2020 12:02	van Veen Grab	36° 51.962	8° 38.039		250	
AL534/2_4-5	08.03.2020 12:20	Mini Corer	36° 51.990	8° 38.072		254	
AL534/2_4-6	08.03.2020 13:01	Mini Corer	36° 52.039	8° 38.116		263	
AL534/2_4-7	08.03.2020 13:42	Mini Corer	36° 52.006	8° 38.108		262	
AL534/2_4-8	08.03.2020 14:07	WP3	36° 51.998	8° 38.098		260	
AL534/2_4-9	08.03.2020 14:21	WP3	36° 52.001	8° 38.066		254	
AL534/2_4-10	08.03.2020 14:36	WP3	36° 51.959	8° 38.025		247	
AL534/2_4-11	08.03.2020 14:57	Bongo Net	36° 51.854	8° 38.122		272	Haul length (m): 1933.8 Volume (m3): 546.8 Sampling depth (m): 35
AL534/2_4-12	08.03.2020 15:48	Bongo Net	36° 51.751	8° 36.862		174	Haul length (m): 1645.5 Volume (m3): 465.3 Sampling depth (m): 20
AL534/2_4-13	08.03.2020 16:19	Bongo Net	36° 51.609	8° 38.023		248	Haul length (m): 2233.2 Volume (m3): 631.4 Sampling depth (m): 20
AL534/2_4-14	08.03.2020 17:08	Neuston-Schlitten	36° 51.811	8° 37.109		174	Net area:0.1346 m^2
AL534/2_4-15	08.03.2020 17:31	Neuston-Schlitten	36° 51.817	8° 37.983		241	Net area:0.1346 m^2
AL534/2_4-16	08.03.2020 17:56	Neuston-Schlitten	36° 51.908	8° 38.886		214	Net area:0.1346 m^2
AL534/2_5-1	09.03.2020 09:55	Underway Water Sampling	37° 43.446	9° 04.597		256	

AL534/2_0_Underway-3	09.03.2020 15:00	Litter Survey	38° 30.528	9° 17.980		136	
AL534/2_6-1	09.03.2020 17:04	Underway Water Sampling	38° 24.771	9° 05.949		104	
AL534/2_7-1	10.03.2020 07:02	CTD	38° 32.398	9° 18.028		122	Depths (m): 114.2, 98.6, 83.6, 73.5, 64.3, 59.4, 47, 36.8, 28.2, 19.7, 9.4, 0.3
AL534/2_7-2	10.03.2020 07:13	van Veen Grab	38° 32.380	9° 18.012		125	
AL534/2_7-3	10.03.2020 07:25	van Veen Grab	38° 32.383	9° 18.001		126	
AL534/2_7-4	10.03.2020 07:33	van Veen Grab	38° 32.370	9° 17.993		127	
AL534/2_7-5	10.03.2020 07:49	Mini Corer	38° 32.379	9° 17.992		126	
AL534/2_7-6	10.03.2020 08:03	Mini Corer	38° 32.388	9° 18.002		124	empty
AL534/2_7-7	10.03.2020 08:15	Mini Corer	38° 32.396	9° 18.028		121	
AL534/2_7-8	10.03.2020 08:29	Mini Corer	38° 32.399	9° 18.027		121	
AL534/2_7-9	10.03.2020 08:43	WP3	38° 32.389	9° 18.029		121	
AL534/2_7-10	10.03.2020 08:55	WP3	38° 32.385	9° 18.054		119	
AL534/2_7-11	10.03.2020 09:06	WP3	38° 32.386	9° 18.101		117	
AL534/2_7-12	10.03.2020 09:22	Bongo Net	38° 32.395	9° 18.113		115	Haul length (m): 1882.5 Volume (m3): 532.3 Sampling depth (m): 40
AL534/2_7-13	10.03.2020 10:06	Bongo Net	38° 32.364	9° 17.874		142	Haul length (m): 1858.5 Volume (m3): 525.5 Sampling depth (m): 40
AL534/2_7-14	10.03.2020 10:43	Bongo Net	38° 32.798	9° 18.621		99	Haul length (m): 2093.4 Volume (m3): 591.9 Sampling depth (m): 40
AL534/2_7-15	10.03.2020 11:26	Neuston-Schlitten	38° 31.947	9° 17.687		177	Net area:0.1346 m^2
AL534/2_7-16	10.03.2020 11:49	Neuston-Schlitten	38° 32.306	9° 18.658		105	Net area:0.1346 m^2
AL534/2_7-17	10.03.2020 12:11	Neuston-Schlitten	38° 32.647	9° 19.599		99	Net area:0.1346 m^2
AL534/2_8-1	10.03.2020 12:41	Underway Water Sampling	38° 33.172	9° 21.039		96	
AL534/2_9-1	10.03.2020 17:01	Underway Water Sampling	39° 07.994	9° 41.508		92	
AL534/2_10-1	11.03.2020 07:51	Underway Water Sampling	41° 35.153	9° 11.293		118	
AL534/2_11-1	11.03.2020 08:14	Underway Water Sampling	41° 39.387	9° 13.682		141	
AL534/2_11-2	11.03.2020 08:22	Litter Survey	41° 40.874	9° 14.516		142	
AL534/2_11-3	11.03.2020 09:10	Litter Survey	41° 49.771	9° 19.664		180	
AL534/2_12-1	11.03.2020 12:30	Litter Survey	42° 27.493	9° 36.937		1714	
AL534/2_13-1	11.03.2020 13:15	Litter Survey	42° 36.039	9° 41.074		1829	
AL534/2_14-1	11.03.2020 14:15	Litter Survey	42° 47.894	9° 44.951		1806	

AL534/2_15-1	11.03.2020 14:16	Litter Survey	42° 48.140	9° 44.985		1787	
AL534/2_16-1	11.03.2020 16:13	Underway Water Sampling	43° 12.282	9° 45.574		2078	
AL534/2_17-1	12.03.2020 08:27	CTD	43° 41.073	5° 42.979		102	Depths (m): 98.7, 89.2, 80.2, 68.6, 60.8, 49.1, 38.7, 29.4, 19.3, 9.3, 1.8, 0.8
AL534/2_17-2	12.03.2020 08:37	van Veen Grab	43° 41.072	5° 43.000		102	
AL534/2_17-3	12.03.2020 08:46	van Veen Grab	43° 41.056	5° 43.060		101	
AL534/2_17-4	12.03.2020 08:56	van Veen Grab	43° 41.059	5° 43.080		99	
AL534/2_17-5	12.03.2020 09:05	van Veen Grab	43° 41.050	5° 43.168		100	
AL534/2_17-6	12.03.2020 09:13	Mini Corer	43° 41.073	5° 43.216		101	
AL534/2_17-7	12.03.2020 09:25	Mini Corer	43° 41.071	5° 43.253		100	
AL534/2_17-8	12.03.2020 09:43	Mini Corer	43° 41.064	5° 43.352		99	
AL534/2_17-9	12.03.2020 10:00	Mini Corer	43° 41.094	5° 43.371		98	
AL534/2_17-10	12.03.2020 10:10	Mini Corer	43° 41.075	5° 43.394		98	
AL534/2_17-11	12.03.2020 10:46	WP3	43° 41.106	5° 43.508		96	
AL534/2_17-12	12.03.2020 10:56	WP3	43° 41.154	5° 43.563		98	
AL534/2_17-13	12.03.2020 11:06	WP3	43° 41.194	5° 43.612		99	
AL534/2_17-14	12.03.2020 11:15	WP3	43° 41.228	5° 43.631		98	
AL534/2_17-15	12.03.2020 11:21	WP3	43° 41.236	5° 43.621		100	
AL534/2_17-16	12.03.2020 11:26	WP3	43° 41.237	5° 43.622		102	
AL534/2_17-17	12.03.2020 11:34	Neuston-Schlitten	43° 41.266	5° 43.691		102	Net area:0.1346 m^2
AL534/2_17-18	12.03.2020 11:58	Neuston-Schlitten	43° 41.599	5° 44.723		104	Net area:0.1346 m^2
AL534/2_17-19	12.03.2020 12:23	Neuston-Schlitten	43° 41.903	5° 45.788		106	Net area:0.1346 m^2
AL534/2_17-20	12.03.2020 12:52	Bongo Net	43° 42.208	5° 47.069		102	Haul length (m): 1301.1 Volume (m3): 367.9 Sampling depth (m): 40
AL534/2_17-21	12.03.2020 13:31	Bongo Net	43° 42.580	5° 48.850		107	Haul length (m): 1411.5 Volume (m3): 399.1 Sampling depth (m): 35
AL534/2_17-22	12.03.2020 14:07	Bongo Net	43° 42.912	5° 50.464		115	Haul length (m): 2139.3 Volume (m3): 604.9 Sampling depth (m): 30
AL534/2_17-23	12.03.2020 15:43	In Situ Pump	43° 40.579	5° 41.840		101	Pump depths: 55, 140 m
AL534/2_17-24	12.03.2020 15:45	Underway Water Sampling	43° 40.579	5° 41.856		98	
AL534/2_18-1	13.03.2020 09:49	Underway Water Sampling	43° 39.411	4° 17.961		1510	
AL534/2_19-1	13.03.2020 15:10	Underway Water Sampling	44° 42.099	4° 12.756		311	
AL534/2_20-1	13.03.2020 20:20	Underway Water Sampling	45° 42.541	3° 43.895		1384	

AL534/2_21-1	16.03.2020 07:16	Underway Water Sampling	47° 32.789	3° 18.265		36	
AL534/2_22-1	16.03.2020 07:50	Underway Water Sampling	47° 34.943	3° 26.482		34	
AL534/2_23-1	16.03.2020 09:46	Underway Water Sampling	47° 38.042	3° 57.669		57	
AL534/2_24-1	16.03.2020 11:00	Underway Water Sampling	47° 42.253	4° 15.292		86	
AL534/2_25-1	16.03.2020 11:20	Litter Survey	47° 43.820	4° 19.623		80	
AL534/2_26-1	16.03.2020 12:25	Litter Survey	47° 48.635	4° 32.718		76	
AL534/2_27-1	16.03.2020 17:04	Underway Water Sampling	48° 20.230	5° 19.007		107	
AL534/2_28-1	16.03.2020 21:29	Underway Water Sampling	48° 57.395	4° 34.448		100	
AL534/2_29-1	17.03.2020 09:03	CTD	49° 56.931	1° 42.923		75	Depths (m): 67.2, 59, 48.6, 39.9, 30, 19.1, 9.9, 3.9, 2.2, 2, 2, 2
AL534/2_29-2	17.03.2020 09:14	van Veen Grab	49° 56.989	1° 42.987		76	only stones
AL534/2_29-3	17.03.2020 09:20	van Veen Grab	49° 57.034	1° 43.086		75	empty
AL534/2_29-4	17.03.2020 09:29	Box Corer	49° 57.061	1° 43.251		76	only stones/gravel and shells recovered
AL534/2_29-5	17.03.2020 09:41	WP3	49° 57.050	1° 43.164		76	
AL534/2_29-6	17.03.2020 09:49	WP3	49° 57.082	1° 43.059		75	
AL534/2_29-7	17.03.2020 09:56	WP3	49° 57.146	1° 43.038		76	
AL534/2_29-8	17.03.2020 10:47	Bongo Net	49° 57.040	1° 43.132		75	Haul length (m): 2237.1 Volume (m3): 632.5 Sampling depth (m): 35
AL534/2_29-9	17.03.2020 11:26	Bongo Net	49° 55.942	1° 44.065		72	Haul length (m): 2538 Volume (m3): 717.6 Sampling depth (m): 30
AL534/2_29-10	17.03.2020 12:21	Bongo Net	49° 57.992	1° 42.591		79	Haul length (m): 2795.4 Volume (m3): 790.4 Sampling depth (m): 25
AL534/2_29-11	17.03.2020 13:00	Neuston-Schlitten	49° 56.354	1° 41.398		74	Net area:0.1346 m^2
AL534/2_30-1	17.03.2020 13:48	Underway Water Sampling	49° 54.348	1° 36.389		69	
AL534/2_31-1	18.03.2020 06:58	CTD	49° 24.133	0° 04.472		17	Depths (m): 16.4, 9.8, 5.8, 0.8, 0.9, 1
AL534/2_31-2	18.03.2020 07:05	van Veen Grab	49° 24.143	0° 04.463		17	
AL534/2_31-3	18.03.2020 07:14	van Veen Grab	49° 24.151	0° 04.455		17	
AL534/2_31-4	18.03.2020 07:18	van Veen Grab	49° 24.156	0° 04.463		17	
AL534/2_31-5	18.03.2020 07:21	van Veen Grab	49° 24.159	0° 04.466		17	
AL534/2_31-7	18.03.2020 07:30	Mini Corer	49° 24.164	0° 04.463		17	
AL534/2_31-8	18.03.2020 07:37	Mini Corer	49° 24.170	0° 04.463		17	empty
AL534/2_31-9	18.03.2020 07:43	Mini Corer	49° 24.176	0° 04.471		17	empty
AL534/2_31-10	18.03.2020 07:50	Box Corer	49° 24.187	0° 04.481		17	discarded

AL534/2_31-11	18.03.2020 07:54	Box Corer	49° 24.192	0° 04.489		17	
AL534/2_31-12	18.03.2020 08:03	Box Corer	49° 24.190	0° 04.511		17	discarded
AL534/2_31-13	18.03.2020 08:06	Box Corer	49° 24.186	0° 04.515		16	
AL534/2_31-14	18.03.2020 08:14	Box Corer	49° 24.186	0° 04.528		16	
AL534/2_31-15	18.03.2020 08:21	Box Corer	49° 24.186	0° 04.538		16	
AL534/2_31-16	18.03.2020 08:26	Box Corer	49° 24.183	0° 04.548		16	
AL534/2_31-17	18.03.2020 08:32	Box Corer	49° 24.184	0° 04.551		16	
AL534/2_31-18	18.03.2020 08:35	Box Corer	49° 24.184	0° 04.554		16	
AL534/2_31-19	18.03.2020 08:40	Box Corer	49° 24.187	0° 04.557		16	
AL534/2_31-20	18.03.2020 08:48	WP3	49° 24.184	0° 04.559		16	
AL534/2_31-21	18.03.2020 08:54	WP3	49° 24.183	0° 04.566		16	
AL534/2_31-22	18.03.2020 08:58	WP3	49° 24.182	0° 04.569		16	Net haul failed
AL534/2_31-23	18.03.2020 09:01	WP3	49° 24.180	0° 04.569		16	
AL534/2_31-24	18.03.2020 09:10	Bongo Net	49° 24.207	0° 04.616		16	Haul length (m): 1405.8 Volume (m3): 397.5 Sampling depth (m): 17
AL534/2_31-25	18.03.2020 09:55	Bongo Net	49° 24.193	0° 04.544		15	Haul length (m): 1309.2 Volume (m3): 370.2 Sampling depth (m): 10
AL534/2_31-26	18.03.2020 10:29	Bongo Net	49° 24.238	0° 06.267		17	Haul length (m): 2013.9 Volume (m3): 569.4 Sampling depth (m): 5
AL534/2_31-27	18.03.2020 11:18	Neuston-Schlitten	49° 24.231	0° 03.433		14	Net area:0.1346 m^2
AL534/2_31-28	18.03.2020 11:53	Neuston-Schlitten	49° 24.288	0° 03.646		14	Net area:0.1346 m^2
AL534/2_31-29	18.03.2020 12:26	Neuston-Schlitten	49° 24.287	0° 03.742		14	Net area:0.1346 m^2
AL534/2_32-1	18.03.2020 13:00	Underway Water Sampling	49° 25.097	0° 07.072		20	
AL534/2_33-1	18.03.2020 14:16	Litter Survey	49° 36.688	0° 09.994		26	
AL534/2_34-1	18.03.2020 15:26	Litter Survey	49° 48.290	0° 07.048		38	
AL534/2_35-1	19.03.2020 07:00	CTD	51° 29.413	-1° 40.761		32	Depths (m): 27.6, 21, 14.6, 8.1, 3.1, 0.1
AL534/2_35-2	19.03.2020 07:06	van Veen Grab	51° 29.414	-1° 40.757		32	
AL534/2_35-3	19.03.2020 07:14	van Veen Grab	51° 29.405	-1° 40.760		32	
AL534/2_35-4	19.03.2020 07:19	van Veen Grab	51° 29.395	-1° 40.752		32	
AL534/2_35-5	19.03.2020 07:24	van Veen Grab	51° 29.389	-1° 40.738		32	
AL534/2_35-6	19.03.2020 07:32	Mini Corer	51° 29.372	-1° 40.720		32	
AL534/2_35-7	19.03.2020 07:42	Mini Corer	51° 29.361	-1° 40.702		32	

AL534/2_35-8	19.03.2020 07:50	Mini Corer	51° 29.348	-1° 40.703		32	
AL534/2_35-9	19.03.2020 08:03	WP3	51° 29.318	-1° 40.655		32	
AL534/2_35-10	19.03.2020 08:08	WP3	51° 29.304	-1° 40.631		32	
AL534/2_35-11	19.03.2020 08:14	WP3	51° 29.295	-1° 40.625		32	
AL534/2_35-12	19.03.2020 08:23	Bongo Net	51° 29.326	-1° 40.620		32	Haul length (m): 1731.9 Volume (m3): 489.7 Sampling depth (m): 18
AL534/2_35-13	19.03.2020 08:58	Bongo Net	51° 30.528	-1° 40.525		28	Haul length (m): 1607.7 Volume (m3): 454.6 Sampling depth (m): 15
AL534/2_35-14	19.03.2020 09:33	Bongo Net	51° 31.655	-1° 41.027		30	Haul length (m): 1388.7 Volume (m3): 392.6 Sampling depth (m): 20
AL534/2_35-15	19.03.2020 10:10	Neuston-Schlitten	51° 32.334	-1° 42.305		37	Net area:0.1346 m^2
AL534/2_35-16	19.03.2020 10:33	Neuston-Schlitten	51° 31.360	-1° 43.225		36	Net area:0.1346 m^2
AL534/2_35-17	19.03.2020 10:57	Neuston-Schlitten	51° 30.230	-1° 43.787		35	Net area:0.1346 m^2
AL534/2_36-1	19.03.2020 14:14	Underway Water Sampling	51° 22.107	-2° 34.010		22	
AL534/2_37-1	19.03.2020 15:50	CTD	51° 26.007	-2° 59.981		18	Depths (m): failed, repeated (37-2)
AL534/2_37-2	19.03.2020 15:55	CTD	51° 25.998	-2° 59.979		18	Depths (m): 16.2, 10.9, 7, 3.8, 0.7
AL534/2_37-3	19.03.2020 16:00	van Veen Grab	51° 25.996	-2° 59.975		19	
AL534/2_37-4	19.03.2020 16:04	van Veen Grab	51° 25.985	-2° 59.961		18	empty
AL534/2_37-5	19.03.2020 16:06	van Veen Grab	51° 25.981	-2° 59.957		18	empty
AL534/2_37-6	19.03.2020 16:07	van Veen Grab	51° 25.976	-2° 59.951		18	
AL534/2_37-7	19.03.2020 16:13	van Veen Grab	51° 25.971	-2° 59.936		18	
AL534/2_37-8	19.03.2020 16:19	Mini Corer	51° 25.958	-2° 59.914		18	
AL534/2_37-9	19.03.2020 16:26	Mini Corer	51° 25.941	-2° 59.891		19	
AL534/2_37-10	19.03.2020 16:32	Mini Corer	51° 25.927	-2° 59.855		19	
AL534/2_37-11	19.03.2020 16:42	Neuston-Schlitten	51° 25.944	-2° 59.839		20	Net area:0.1346 m^2
AL534/2_37-12	19.03.2020 17:17	Neuston-Schlitten	51° 25.976	-3° 00.092		18	Net area:0.1346 m^2
AL534/2_37-13	19.03.2020 17:40	Neuston-Schlitten	51° 26.718	-3° 00.456		21	Net area:0.1346 m^2
AL534/2_37-14	19.03.2020 18:14	Bongo Net	51° 26.149	-3° 00.436		17	Haul length (m): 3093.6 Volume (m3): 874.7 Sampling depth (m): 5
AL534/2_37-15	19.03.2020 18:49	Bongo Net	51° 27.153	-3° 00.894		19	Haul length (m): 2599.8 Volume (m3): 735.1 Sampling depth (m): 5
AL534/2_37-16	19.03.2020 19:30	Bongo Net	51° 27.183	-3° 00.569		24	Haul length (m): 2070.3 Volume (m3): 585.4 Sampling depth (m): 5

AL534/2_37-17	19.03.2020 20:06	WP3	51° 28.254	-3° 00.350		20	
AL534/2_37-18	19.03.2020 20:11	WP3	51° 28.277	-3° 00.163		19	
AL534/2_37-19	19.03.2020 20:15	WP3	51° 28.294	-3° 00.046		20	
AL534/2_38-1	20.03.2020 07:09	Underway Water Sampling	53° 20.225	-4° 41.394		25	
AL534/2_39-1	20.03.2020 11:07	CTD	53° 38.799	-5° 11.848		27	Depths (m): 25.4, 18, 11, 5.7, 1.7
AL534/2_39-2	20.03.2020 11:14	van Veen Grab	53° 38.799	-5° 11.802		27	
AL534/2_39-3	20.03.2020 11:21	van Veen Grab	53° 38.804	-5° 11.754		27	
AL534/2_39-4	20.03.2020 11:22	van Veen Grab	53° 38.800	-5° 11.741		27	empty
AL534/2_39-5	20.03.2020 11:27	van Veen Grab	53° 38.791	-5° 11.709		27	
AL534/2_39-6	20.03.2020 11:35	Mini Corer	53° 38.800	-5° 11.631		27	
AL534/2_39-7	20.03.2020 11:44	Mini Corer	53° 38.796	-5° 11.584		27	
AL534/2_39-8	20.03.2020 11:52	Mini Corer	53° 38.787	-5° 11.552		27	
AL534/2_39-9	20.03.2020 12:02	Mini Corer	53° 38.794	-5° 11.502		27	
AL534/2_39-10	20.03.2020 12:14	Neuston-Schlitten	53° 38.883	-5° 11.486		27	Net area:0.1346 m^2
AL534/2_39-11	20.03.2020 12:37	Neuston-Schlitten	53° 39.619	-5° 11.972		28	Net area:0.1346 m^2
AL534/2_39-12	20.03.2020 13:00	Neuston-Schlitten	53° 40.390	-5° 12.216		28	Net area:0.1346 m^2
AL534/2_39-13	20.03.2020 13:38	WP3	53° 39.607	-5° 12.224		28	
AL534/2_39-14	20.03.2020 13:43	WP3	53° 39.631	-5° 12.181		28	
AL534/2_39-15	20.03.2020 13:49	WP3	53° 39.638	-5° 12.177		28	
AL534/2_39-16	20.03.2020 13:55	Bongo Net	53° 39.715	-5° 12.193		29	Flowmeter did not work
AL534/2_39-17	20.03.2020 14:29	Bongo Net	53° 40.924	-5° 12.255		29	Haul length (m): 1688.4 Volume (m3): 477.4 Sampling depth (m): 5
AL534/2_39-18	20.03.2020 15:03	Bongo Net	53° 42.125	-5° 12.419		31	Haul length (m): 1559.7 Volume (m3): 441 Sampling depth (m): 5
AL534/2_39-19	20.03.2020 15:38	Bongo Net	53° 43.339	-5° 12.501		32	Haul length (m): 1654.5 Volume (m3): 467.8 Sampling depth (m): 5
AL534/2_40-1	23.03.2020 07:28	Underway Water Sampling	53° 51.616	-8° 43.959		18	
AL534/2_41-1	23.03.2020 09:17	CTD	53° 52.248	-9° 15.025		16	Depths (m): 9, 5.8, 2.8, 0.8, 0.7
AL534/2_41-2	23.03.2020 09:34	van Veen Grab	53° 51.814	-9° 16.611		11	empty
AL534/2_41-3	23.03.2020 09:38	van Veen Grab	53° 51.810	-9° 16.587		11	
AL534/2_41-4	23.03.2020 09:47	van Veen Grab	53° 51.813	-9° 16.591		11	empty
AL534/2_41-5	23.03.2020 09:54	van Veen Grab	53° 51.799	-9° 16.648		11	empty

AL534/2_41-6	23.03.2020 09:59	Neuston-Schlitten	53° 51.792	-9° 16.523		11	Net area:0.1346 m^2
AL534/2_41-7	23.03.2020 10:21	Neuston-Schlitten	53° 51.953	-9° 15.773		10	Net area:0.1346 m^2
AL534/2_41-8	23.03.2020 10:51	Neuston-Schlitten	53° 51.753	-9° 16.328		10	Net area:0.1346 m^2
AL534/2_41-9	23.03.2020 12:38	van Veen Grab	53° 51.508	-9° 17.153		10	
AL534/2_41-10	23.03.2020 12:46	van Veen Grab	53° 51.485	-9° 17.360		12	
AL534/2_44-1	23.03.2020 13:19	Underway Water Sampling	53° 52.883	-9° 13.442		19	
AL534/2_42-1	23.03.2020 13:38	Underway Water Sampling	53° 52.956	-9° 08.733		16	
AL534/2_43-1	23.03.2020 14:08	Underway Water Sampling	53° 51.633	-9° 01.049		12	
AL534/2_45-1	23.03.2020 14:24	Underway Water Sampling	53° 50.935	-8° 56.432		12	
AL534/2_46-1	23.03.2020 14:49	Underway Water Sampling	53° 50.676	-8° 48.660		11	
AL534/2_47-1	23.03.2020 16:46	Underway Water Sampling	54° 02.321	-8° 15.532		10	
AL534/2_48-1	24.03.2020 06:56	CTD	54° 05.077	-8° 05.070		21	Depths (m): 19.1, 13.3, 8.4, 3.9, 1
AL534/2_48-2	24.03.2020 07:03	van Veen Grab	54° 05.089	-8° 05.052		22	
AL534/2_48-3	24.03.2020 07:12	van Veen Grab	54° 05.116	-8° 05.029		21	
AL534/2_48-4	24.03.2020 07:20	van Veen Grab	54° 05.121	-8° 05.010		22	
AL534/2_48-5	24.03.2020 07:29	Mini Corer	54° 05.129	-8° 05.005		22	
AL534/2_48-6	24.03.2020 07:37	Mini Corer	54° 05.141	-8° 05.007		22	
AL534/2_48-7	24.03.2020 07:44	Mini Corer	54° 05.148	-8° 05.012		22	
AL534/2_48-8	24.03.2020 07:53	WP3	54° 05.162	-8° 05.016		22	
AL534/2_48-9	24.03.2020 08:09	WP3	54° 05.202	-8° 05.202		23	
AL534/2_48-10	24.03.2020 08:16	WP3	54° 05.300	-8° 05.564		23	
AL534/2_48-11	24.03.2020 08:24	Bongo Net	54° 05.279	-8° 05.793		23	Haul length (m): 1868.4 Volume (m3): 528.3 Sampling depth (m): 5
AL534/2_48-12	24.03.2020 08:59	Bongo Net	54° 04.324	-8° 08.052		21	Haul length (m): 1765.8 Volume (m3): 499.3 Sampling depth (m): 5
AL534/2_48-13	24.03.2020 09:31	Bongo Net	54° 04.528	-8° 11.103		19	Haul length (m): 1744.8 Volume (m3): 493.3 Sampling depth (m): 5
AL534/2_49-1	24.03.2020 11:13	CTD	53° 59.513	-8° 27.168		14	Depths (m): 10.6, 5.8, 1.4, 1
AL534/2_49-2	24.03.2020 11:20	van Veen Grab	53° 59.513	-8° 27.183		14	
AL534/2_49-3	24.03.2020 11:24	van Veen Grab	53° 59.514	-8° 27.182		14	
AL534/2_49-4	24.03.2020 11:27	van Veen Grab	53° 59.515	-8° 27.181		14	
AL534/2_49-5	24.03.2020 11:33	Mini Corer	53° 59.520	-8° 27.180		14	

AL534/2_49-6	24.03.2020 11:39	Mini Corer	53° 59.512	-8° 27.185		14	
AL534/2_49-7	24.03.2020 11:45	Mini Corer	53° 59.508	-8° 27.185		14	
AL534/2_49-8	24.03.2020 11:54	Bongo Net	53° 59.523	-8° 27.388		14	Haul length (m): 471.3 Volume (m3): 133.3 Sampling depth (m): 5
AL534/2_49-9	24.03.2020 12:08	Bongo Net	53° 59.545	-8° 28.088		14	Haul length (m): 591 Volume (m3): 167.1 Sampling depth (m): 5
AL534/2_49-10	24.03.2020 12:22	Bongo Net	53° 59.537	-8° 28.901		14	Haul length (m): 520.8 Volume (m3): 147.3 Sampling depth (m): 5
AL534/2_49-11	24.03.2020 12:39	WP3	53° 59.333	-8° 28.826		12	
AL534/2_49-12	24.03.2020 12:42	WP3	53° 59.338	-8° 28.811		12	
AL534/2_49-13	24.03.2020 12:46	WP3	53° 59.340	-8° 28.810		12	
AL534/2_49-14	24.03.2020 12:52	Neuston-Schlitten	53° 59.341	-8° 28.854		12	Net area:0.1346 m^2
AL534/2_49-15	24.03.2020 13:05	Neuston-Schlitten	53° 59.459	-8° 29.676		13	Net area:0.1346 m^2
AL534/2_49-16	24.03.2020 13:17	Neuston-Schlitten	53° 59.513	-8° 30.358		13	Net area:0.1346 m^2
AL534/2_50-1	25.03.2020 06:52	CTD	53° 52.510	-6° 16.654		31	For sensor data only
AL534/2_50-2	25.03.2020 06:59	WP3	53° 52.481	-6° 16.690		31	
AL534/2_50-3	25.03.2020 07:05	WP3	53° 52.485	-6° 16.763		30	
AL534/2_50-4	25.03.2020 07:10	WP3	53° 52.498	-6° 16.851		31	
AL534/2_51-1	25.03.2020 09:04	Underway Water Sampling	53° 36.768	-6° 24.872		15	
AL534/2_52-1	25.03.2020 10:31	CTD	53° 32.710	-6° 41.292		22	Depths (m): 19.3, 14.5, 9.9, 4.6, 1
AL534/2_52-2	25.03.2020 10:37	van Veen Grab	53° 32.653	-6° 41.280		21	
AL534/2_52-3	25.03.2020 10:42	van Veen Grab	53° 32.616	-6° 41.273		20	
AL534/2_52-4	25.03.2020 10:46	van Veen Grab	53° 32.601	-6° 41.265		20	
AL534/2_52-5	25.03.2020 10:53	Mini Corer	53° 32.596	-6° 41.293		20	
AL534/2_52-6	25.03.2020 10:59	Mini Corer	53° 32.584	-6° 41.363		20	
AL534/2_52-7	25.03.2020 11:05	Mini Corer	53° 32.544	-6° 41.408		20	
AL534/2_52-8	25.03.2020 11:11	Mini Corer	53° 32.516	-6° 41.450		20	
AL534/2_52-9	25.03.2020 11:19	WP3	53° 32.501	-6° 41.511		20	
AL534/2_52-10	25.03.2020 11:25	WP3	53° 32.507	-6° 41.540		20	
AL534/2_52-11	25.03.2020 11:29	WP3	53° 32.509	-6° 41.569		20	
AL534/2_52-12	25.03.2020 11:35	Bongo Net	53° 32.523	-6° 41.605		21	Haul length (m): 691.2 Volume (m3): 195.4 Sampling depth (m): 5

AL534/2_52-13	25.03.2020 11:49	Bongo Net	53° 32.892	-6° 40.906		23	Haul length (m): 554.7 Volume (m3): 156.8 Sampling depth (m): 5
AL534/2_52-14	25.03.2020 12:14	Bongo Net	53° 31.937	-6° 43.007		17	Haul length (m): 665.4 Volume (m3): 188.1 Sampling depth (m): 5
AL534/2_52-15	25.03.2020 12:29	Neuston-Schlitten	53° 32.321	-6° 41.888		19	Net area:0.1346 m^2
AL534/2_52-16	25.03.2020 12:42	Neuston-Schlitten	53° 32.814	-6° 40.995		21	Net area:0.1346 m^2
AL534/2_52-17	25.03.2020 12:54	Neuston-Schlitten	53° 32.672	-6° 41.510		22	Net area:0.1346 m^2
AL534/2_53-1	25.03.2020 21:27	Underway Water Sampling	53° 37.623	-8° 27.722		19	
AL534/2_54-1	25.03.2020 21:33	Underway Water Sampling	53° 38.257	-8° 26.320		15	
AL534/2_55-1	25.03.2020 21:45	Underway Water Sampling	53° 39.409	-8° 23.833		17	
AL534/2_56-1	25.03.2020 22:00	Underway Water Sampling	53° 41.180	-8° 21.322		17	
AL534/2_57-1	25.03.2020 22:18	Underway Water Sampling	53° 43.208	-8° 17.177		14	
AL534/2_58-1	25.03.2020 22:27	Underway Water Sampling	53° 44.063	-8° 15.009		13	
AL534/2_58-1	25.03.2020 22:28	Underway Water Sampling	53° 44.099	-8° 14.908		13	
AL534/2_59-1	25.03.2020 23:07	Underway Water Sampling	53° 49.411	-8° 07.521		12	
AL534/2_60-1	25.03.2020 23:35	CTD	53° 53.169	-8° 06.240		17	Depths (m): 14.7, 9.5, 4.8, 1.1
AL534/2_60-2	25.03.2020 23:42	van Veen Grab	53° 53.153	-8° 06.227		17	
AL534/2_60-3	25.03.2020 23:46	van Veen Grab	53° 53.141	-8° 06.210		17	
AL534/2_60-4	25.03.2020 23:50	van Veen Grab	53° 53.134	-8° 06.189		17	
AL534/2_60-5	25.03.2020 23:56	Mini Corer	53° 53.124	-8° 06.156		17	
AL534/2_60-6	26.03.2020 00:01	Mini Corer	53° 53.106	-8° 06.127		18	
AL534/2_60-7	26.03.2020 00:09	Mini Corer	53° 53.110	-8° 06.104		17	
AL534/2_60-8	26.03.2020 00:14	Mini Corer	53° 53.111	-8° 06.090		18	
AL534/2_60-9	26.03.2020 00:23	WP3	53° 53.117	-8° 06.079		18	
AL534/2_60-10	26.03.2020 00:27	WP3	53° 53.119	-8° 06.069		19	
AL534/2_60-11	26.03.2020 00:32	WP3	53° 53.122	-8° 06.066		19	
AL534/2_60-12	26.03.2020 00:38	Bongo Net	53° 53.211	-8° 05.924		18	Haul length (m): 871.8 Volume (m3): 246.5 Sampling depth (m): 5
AL534/2_60-13	26.03.2020 00:51	Bongo Net	53° 53.632	-8° 05.103		17	Haul length (m): 849 Volume (m3): 240 Sampling depth (m): 5
AL534/2_60-14	26.03.2020 01:04	Bongo Net	53° 54.072	-8° 04.174		15	Haul length (m): 800.1 Volume (m3): 226.2 Sampling depth (m): 5
AL534/2_60-15	26.03.2020 01:20	Neuston-Schlitten	53° 54.658	-8° 03.019		13	Net area:0.1346 m^2

AL534/2_60-16	26.03.2020 01:32	Neuston-Schlitten	53° 55.150	-8° 02.067		11	Net area:0.1346 m^2
AL534/2_60-17	26.03.2020 01:44	Neuston-Schlitten	53° 55.719	-8° 01.239		12	Net area:0.1346 m^2

7 Data and Sample Storage and Availability

All data obtained during the cruise are stored on a GEOMAR virtual drive that is backed up daily. Paper protocols filled out during the cruise were entered electronically during the cruise, and are therefore within the electronic back-up scheme. Hard copies have also been saved to subsequently resolve possible data entry errors as necessary.

All cruise metadata – including output of the onboard DSHIP-System - have been entered in the GEOMAR Ocean Science Information System (OSIS), managed by the Kiel Data Management Team (KDMT), and intended for permanent archiving of such data. The data are freely available via: https://portal.geomar.de/metadata/leg/list (keyword "AL534").

All data collected during the cruise will ultimately be made publicly available. Hydrographic (CTD) data will be submitted to the OSIS database within one year from the cruise. The KDMT team will assist with the publication of data in the public repository PANGAEA as a long-term archive for access to the data. Most of the data are intended for specific publications, and will be published openly along with the peer-reviewed article.

Table 3. Overview of data availability

Parameters	**Database**	**Available**	**Free Access**	**Contact person**	**Present affiliation**	**Contact**
CTD sensor data	OSIS[1]	February 2021	06.2023	Aaron Beck	GEOMAR	ajbeck@geomar.de
Plastic leachate and contaminant concentrations	OSIS / PANGAEA[2]	December 2021	06.2023	Aaron Beck	GEOMAR	ajbeck@geomar.de
Analysis results for organic contaminants	coastMap[3] / PANGAEA	after publication	*n.s.*	Andreas Wittmann	HZG	andreas.wittmann@hzg.de
MP concentrations in environmental samples	*n.s.*	Summer/ Autumn 2021	*n.s.*	Joana Raimundo	IPMA	jraimundo@ipma.pt
MP concentrations in environmental samples	*n.s.*	Summer/ Autumn 2021	*n.s.*	Clara Lopes	IPMA	clara.lopes@ipma.pt
MPs distribution, ecological setting, meiofauna community	*n.s.*	2021	*n.s.*	Gabriella Pantó	UGent	Gabriella.Panto@UGent.be
Sediment geochemical data	PANGAEA	Jan 2021	06.2023	Matthias Haeckel	GEOMAR	mhaeckel@geomar.de

[1] https://portal.geomar.de/metadata/

[2] https://www.pangaea.de/

[3] https://hcdc.hzg.de/campaign_db/#/download

n.s.: not specified

8 Acknowledgements

Cruise AL534/2 was planned, coordinated, and conducted by GEOMAR Helmholtz Centre for Ocean Research Kiel, with participation of colleagues from six additional institutes from Germany and the European Union. The cruise was funded by the Deutsche Forschungsgemeinschaft (DFG) through the GPF review process (GPF 20-1_050). Additional support was provided by the GEOMAR Helmholtz Centre for Ocean Research Kiel and the Bundesministerium für Bildung und Forschung (BMBF) through the project HOTMIC (project number 03F0851A). We are grateful to Captain Jan Lass and the officers and crew of RV ALKOR for their expertise and support on the successful and enjoyable expedition, despite the stressful conditions of the growing COVID pandemic on land. We also thank the following diplomatic offices for permission to perform sampling in national waters: Service public Affaires étrangères, Commerce extérieur et Coopération au Développement (Belgium), Foreign & Commonwealth Office (United Kingdom), Ministerio de Asuntos Exteriores, Unión Europea y Cooperación (Spain), Ministério dos Negócios Estrangeiros (Portugal), Rijksdienst voor Ondernemend Nederland (The Netherlands), and the Ministère de l'Europe et des Affaires étrangères (France). Finally, we gratefully acknowledge logistical support from our colleagues at the GEOMAR Technik- und Logistik Zentrum (TLZ).

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10 Abbreviations

AMPA	aminomethylphosphonic acid
ASE	accelerated solvent extraction
BC	box corer
BP-3	Benzophenone 3
CNS	carbon, nitrogen, sulfur
CUPs	current use pesticides
EHMC	ethyl-hexyl-methoxycinnamate
EOPs	emerging organic pollutants
FIP	fipronil
FMOC-Cl	9-Fluorenylmethoxycarbonyl chloride
HFPO-DA	hexafluoropropylene oxide dimer acid
IC	ion chromatography
ICP-AES	atomic emission spectroscopy with inductively coupled plasma
LC-QqQ	Liquid chromatography triple quadrupole
LOQ	Limit of Quantification
MeOH	methanol
MIC	mini multiple corer
NNIs	neonicotinoids
PFAS	per- and polyfluoroalkyl substances
POC	particulate organic carbon
PON	particulate organic nitrogen
PP	polypropylene
TS	total sulfur
UV	ultraviolet
UVAs	Ultraviolet absorbers
VGRAB	van Veen grab
WWTP	wastewater treatment plant